CHAPTER - 2
TAXONOMY

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2.1 Introduction

Aquatic heteropteran bugs are most abundant in aquatic ecosystems. Globally aquatic and semi-aquatic bugs consist of around 4656 species belonging to the three Infraorders, 20 families and 326 genera (Polhemus & Polhemus, 2007a). Around 1100 species remain undescribed globally (Polhemus & Polhemus, 2007b). Of the 4656 water bugs, 1103 species occur in the Oriental region and 1289 species belong to the Neotropical region (Basu & Subramanian, 2017). India has represented by 325 species belonging to 84 genera and 18 families of aquatic hemipterans (Thirumalai, 1999c, 2002a, 2007; Basu & Subramanian, 2017). Recent additions involve twelve new species and two new genera, described since 2017 (Basu *et al.,* 2017a, 2018a; Jehamalar *et al*., 2018b, 2018c; Zettel & Laciny, 2021). The present number of identified water bugs are 337 species under 86 genera and 18 families from India.

In Kerala, 85 species under 46 genera and 14 families of three infraorders are known based on the checklist of Zoological Survey of India (Thirumalai, 2002a, 2007) and from the list of published literature on Indian aquatic bugs (Thriumalai, 1986; Thirumalai & Radhakrishnan, 1999; Gupta & Khandelwal, 2003; Zettel, 2013; Bismi & Pillai, 2017; Zettel & Laciny, 2021). The knowledge of aquatic and semiaquatic heteropteran bugs of Kerala are limited to taxonomic preliminaries, including recording of species from different parts of the state. The only information available is the taxonomic description of 17 species under 5 families of aquatic heteropterans from Kerala are Silent Valley (Thriumalai, 1986) and Kasaragod area (Thirumalai & Radhakrishnan, 1999). This study is an attempt to consolidate the knowledge of aquatic heteropterans by throwing more light on the present taxonomic status of these aquatic bugs. This study is concentrated on the taxonomy of aquatic heteropteran bugs from

different selected habitats of Kerala and provided the taxonomic description, habitat, and locations of all the collected species.

2.2 Review of Literature

Many studies have been reported on the aquatic insects including water bugs from India. Very few studies were carried out regarding the aquatic and semiaquatic hemipteran bugs from Kerala. This literature review mainly focused on the aquatic and semiaquatic fauna from India and an important literature from other countries were also included. Thirumalai (1983) reported a short communication on the new record of two species of the genus *Anisops* such as *A. batillifrons* Lundbald and *A. debilis* Gerstaeker from the lower Western Ghats, Kerala. Kumari & Nair (1984) described the life history of the aquatic hemipteran bug *Ranatra filiformis* coming under the Family Nepidae. This study was conducted in Trivandrum, Kerala with the ten nymphs of *R. filiformis*. The bug attained adult stages in 58 days and a total of five lifecycle stages achieved from egg to adult. The different instars of *R. filiformis* was clearly mentioned in the study. From the observations of the biometric studies the measurements of the body length, length and width of head, length and width of thorax, length and width of abdomen, length of rostrum, length of respiratory siphon, length of foreleg, mid leg, and hind leg. These measurements basically according to the average of six individuals of *R. filiformis*. The body measurement as well as the developmental stages were different from species to species. Jayakumar & Mathavan (1985) described the colonization of the aquatic heteropteran species *Laccotrephes griseus* belonging to the Family Nepidae. This insect species was found in the littoral zones of the aquatic habitat and in temporary water ecosystems. This study was conducted in a laboratory condition. Final instars of nymphs were collected from the aquatic habitat and reared in the aquarium tank. The freshly emerged ten species of *L. griseus* were selected for the study. The successful colonization as well as the reproductive behaviour were observed thoroughly. The mating was done after 15 days, and it was completed within 3 – 5 minutes. This study clearly recorded the repeated egg laying process of this aquatic heteropteran bug species. Thirumalai (1986) studied the two families of aquatic heteropteran bugs such as Gerridae

and Notonectidae from Silent Valley, Palakkad District, Kerala. This study revealed that the 9 species belongs to 6 genera were recorded in the Family Gerridae, in which five new species such as *Tenagogonus (Limnometra) longispinulus* sp. nov., *Pleciobates nostras* sp. nov., *P. indicus* sp. nov., *Metrocoris malabaricus* sp. nov., and *M. variegans* sp. nov. Two species belongs to single genus was represented in the Family Notonectidae. The species *Pleciobates* Esaki reported for the first time in India. Moreover, the parameres and endosoma of *Ventidius aquarius* was described for first time from India.

Polhemus & Polhemus (1995) reported the water striders of Subfamily Trepobatinae under the Family Gerridae from New Guinea and surrounding regions. This study was revealed that the nine genera of the Tribe Trepobatini were described in the third series. A detailed description as well as the taxonomical identification key of these nine genera were also provided in this report. Nieser (1996) reported two new species of *Ranatra* belonging to the Family Nepidae from Southeast Asia. The two species namely *R. akoitachta* and *R. odontomeros* were reported. The morphological description as well as the comparative notes of these species were also provided. Thirumalai & Radhakrishnan (1999) recorded the aquatic hemipteran bugs from Kasaragod District, Kerala. This study revealed that a total of 8 species classified under 6 genera and 3 families of aquatic and semiaquatic bugs were represented. The three families such as Family Notonectidae, Belostomatidae, and Gerridae. The eight species of water bugs viz., *Enithares fusca, E. hungerfordi, Lethocerus indicus, Limnometra anadyomene, Cylindrostethus productus, Ptilomera (P.) agroides, Metrocoris malabaricus*, and *Ventidius (V.) aquarius*. The diagnostic characteristics and distribution of these water bugs were provided. Thirumalai (1999a) revealed a checklist of aquatic and semiaquatic bugs of Tamil Nadu, India. This was indicated that a total of 95 species under 40 genera and 13 families were reported from Tamil Nadu. Thirumalai (1999b) also recorded a new genus of Subfamily Microveliinae under the Family Veliidae Northeast India. This study proposed a new genus name *Aqualavelia* sp. nov. The species *A. occulata* sp. nov., was collected from the slow flowing forest streams of Arunachal Pradesh. The identification key to all the Microveliinae species known from

India were also provided. Thirumalai (1999c) also reported the aquatic and semiaquatic heteropterans in India. Thirumalai & Krishnan (2000) studied the fauna of the Infraorder Gerromorpha from the states of Western Ghats, India. This study comprised of a total of 64 species were reported from Western Ghats, of which 35 species belongs to 24 genera and 5 families were recorded from Karnataka, 30 species coming under 19 genera and 5 families from Kerala, 18 species under 13 genera and 4 families from Maharashtra, and 43 species accommodated in 25 genera and 5 families from Tamil Nadu.

Thirumalai (2002a) reported a list on the water bugs of Infraorder Gerromorpha from the Order Hemiptera in India. A total of 128 species belongs to 43 genera and 5 families were observed during the study. In which a total species, 76 species under 25 genera were collected from the Family Gerridae, 15 species belonging to 4 genera from the Family Hebridae, 3 species of a genus from the Family Hydrometridae, 3 species of a genus from the Family Mesoveliidae, and 31 species of 13 genera were recorded from the Family Veliidae. The detailed description and distribution of those semi-aquatic bugs in India were also provided. Thirumalai (2002b) also recorded the checklist of aquatic heteropteran species from various aquatic ecosystems of Rajasthan, India. A total of twelve aquatic habitat were studied. This list comprised those 25 species of water bugs belonging to 16 genera and 9 families. Among this the Family Gerridae, Veliidae, Mesoveliidae, Hydrometridae, Notonectidae, Nepidae, Belostomatidae, Pleidae, and Corixidae were recorded in the checklist. Gupta & Khandelwal (2003) described a new species of the genus *Pseudovelia* under the Family Veliidae from Kerala, India. This study revealed the species of *Pseudovelia* (*P.*) *lingula* and their diagnostic characters were provided. Eversham & Prunier (2003) reported the description of the water bugs as nature reserve monitoring. Some species of greater water boatman and saucer bug can inject their digestive enzymes with narrow beak and thereby impose painful wound. The study was revealed that the key to the all the species of aquatic hemipterans observed in Nene Valley and other species from Northants. The *Hydrometra* species viz., *H. stagnorum* and *H. gracilenta* were not found in Northants. Nieser (2004) provided a third guide to the aquatic heteropteran families of Pleidae and Notonectidae from Singapore and Peninsular Malaysia. This was revealed that the Family Pleidae comprised of two

species under single genus and Family Notonectidae represented by 11 species belongs to 4 genera. Diagnostic characters as well as the distributional data were also given in this guide. Thirumalai (2004) recorded a checklist of aquatic and semiaquatic hemipteran bugs of Karnataka, India. This study revealed that 67 species accommodated in 40 genera and 12 families were recorded during the five years of study. Thirumalai & Kumar (2005) reported the aquatic and semiaquatic heteropteran bugs of Karaikal and Pondicherry, Tamil Nadu. This study recorded a total of 20 species coming under 15 genera and 9 families of water bugs. This was provided the diagnostic characters, distribution, and the key to the families of Pondicherry state.

Thirumalai (2006) reported a short communication on the first record of the aquatic bug species *Micronecta decorata* Lundblad from lower Shiwalik hills, Himachal Pradesh, India. This was comprised of 4 males; 4 females and 12 immature stages of this species were collected from the marshy areas of this region. Deepa & Rao (2007) studied the aquatic hemipteran bugs of Pocharam lake of Andhra Pradesh. Seven village spots passing through the lake was selected for the collection of aquatic bugs. A total of eight species belonging to four families and five genera were collected. Among these Family Nepidae, Belostomatidae, Corixidae, and Gerridae were reported during the study. Thirumalai *et al*. (2007) described a checklist of aquatic and semi-aquatic heteropteran bugs of Madhya Pradesh, India. This study revealed that the three families such as Family Naucoridae, Aphelocheiridae, and Ochteridae were reported first time from the state. A total of 57 species of aquatic and semi-aquatic hemipterans belonging to 13 families were documented. Among this list 33 species of water bugs reported for first time from Madhya Pradesh. Thirumalai (2007) also reported a synoptic list of 153 species of the Infraorder Nepomorpha from India. Thirumalai & Sharma (2008) reported the species *Ranatra titilaensis* classified under the Family Nepidae in Jabalpur District, Madhya Pradesh. This species was recorded for first time in Madhya Pradesh. The study was conducted in nine localities for the collection of this species. A total of 111 individuals including immature stages of this *R. titilaensis* were collected. In which 23 males, 42 females and 46 immatures were obtained. Aland *et al*. (2010) described the heteropteran fauna of Amba reserved forest, Western Ghats, Maharashtra. A total of 44

species of 36 genera under 8 families of heteropteran bugs was observed during the entire study period. The 9 families viz., Coreidae, Pyrrhochoridae, Lygaeidae, Pentatomidae, Gerridae, Belostomatidae, Nepidae, and Rhyparochoridae were found in the Amba forest. Among these Family Pentatomidae represented maximum number of species. This study indicated that the species richness was greater in the study area due to the variety of ecological conditions of the forest. Hershey *et al*. (2010) described the ecology of aquatic insect assemblages. This report was revealed that the diversity of aquatic insects, physical constrains, lentic and lotic insect fauna, saline and specialized habitats of aquatic insect communities. This was indicated the role of aquatic insect in biomonitoring studies, life history strategies of these insect fauna, human impact on these aquatic insects and insect-mediated processes. Kshirsagar (2010) worked on the diversity of water bugs from the lentic water bodies of Pune District, Maharashtra. A total of 348 individuals of aquatic bugs were collected from four localities and this belonging to 10 species, 7 genera, 4 families, and 2 suborders were recorded. The Family Nepidae, Belostomatidae, Naucoridae, and Gerridae were observed. From this *Diplonychus rusticus* was the dominant species found in the lentic water bodies of Pune District. Hazarika & Goswami (2010) studied on the aquatic hemipterans of Gauhati University, Guwahati, Assam. A total of 14 species belonging to 12 genera and 7 families of water bugs were recorded. Family Nepidae was the highest number species followed by Gerridae and Belostomatidae. Only one species of water bugs was recorded in the families such as Family Pleidae, Corixidae, Notonectidae, Hydrometridae, and Mesoveliidae. Only 10 species were recorded in second pond while all the species of aquatic heteropteran bugs were found in first pond. This study revealed that the diversity of these water bugs was high in the freshwater bodies of Assam. Das & Gupta (2010) surveyed a seasonal study on the aquatic bugs was conducted in agricultural fields and rain pool ecosystem of Cachar District, Assam. This study revealed that no significant relationships among the insect diversity, density, and physico-chemical factors in the agricultural fields. Whereas in rain pools, the density of aquatic bugs showed significant relationship with all the physico-chemical parameters except electrical conductivity and total dissolved solid while the diversity showed significant relationship with all the physico-chemical factors except rainfall, electrical conductivity, and total suspended

solid. A total of 7 families, 10 genera and 12 species of Hemipterans were recorded in the rain pools whereas, 5 families, 8 genera and 10 species were obtained in the agricultural fields. Family Gerridae, Notonectidae, Corixidae, Belostomatidae, and Nepidae were found in both the rain pools and agricultural fields while the Family Mesoveliidae, Hydrometridae were present only in rain pool ecosystem. The diversity index was highest in both habitats. The seasonal variation in the diversity of aquatic bugs were revealed. From this the Berger Parker index of dominance of agricultural fields was highest in post monsoon period and in rain pools it was highest in pre monsoon season. The Shannon-Weiner diversity index value was highest in monsoon period in both the habitats. The evenness index value was maximum in pre-monsoon in the agricultural field while it was highest in post-monsoon. The density of aquatic heteropteran bugs was found minimum in agricultural field when compared to the density of water bugs in rain pool ecosystem.

Shoeb *et al*. (2011) suggested a new records of Naucorid bugs under the Family Naucoridae in India. The study was carried out from various regions of India from different habitats. The three bugs of the genus *Naucoris* were previously recorded viz., *N. scutellaris, N. sordidus*, and *N. vividus*. The species *N. nanitalensis* was the new species in India. This species was collected from Uttaranchal. This *N. nanitalensis* was closely related to the species *N. vividus*. The original description of this species and the comparison between the other three species were also provided during the study. Chandra & Jehamalar (2011) recorded the four new species of aquatic Heteroptera from Madhya Pradesh, India. The four new species viz., *Gerris nepalensis, Mesovelia horvathi, Valleriola cicindeloides*, and *Anisops kuroiwae* classified under the Infraorders Gerromorpha, Nepomorpha, and Leptopodomorpha. The diagnostic features as well as the distribution of these aquatic heteropterans were provided. Moreira *et al*. (2011) suggested the identification key of the Family Gerridae from the Infraorder Gerromorpha in Amazon River floodplain, Brazil. A total of 18 species under 7 genera were reported from the study. The important characters of the species used for the identification and preparation of key such as coloration pattern of the water bug, presence of setae and their distribution, the sizes of body and leg segments, apical abdominal segment

modifications, and male external genitalia. The species *Cylindrostethus bassleri* was reported for the first time in Brazil. Zettel *et al*. (2011) provided a seventh part of a series of guide to the aquatic heteropteran family of Helotrephidae from Singapore and Peninsular Malaysia. This was represented by a total of 11 species under 7 genera and 2 subfamilies. Identification key, structural and distributional data were also provided. Das & Gupta (2012) worked on the different seasonal variation of the Hemipteran insect community of a temple pond near Silchar, Cachar District, Assam, North-eastern India. A total of 7 families coming under 11 genera and 14 species were recorded. The highest number of Hemipterans was obtained in post-monsoon followed by pre-monsoon and the monsoon seasons. The diversity and density of these insects was lowest in winter. But Berger Parker index of dominance was more in winter period. Four dominant and three sub-dominant species were found in the pond. Sharma & Agrawal (2012) reported the aquatic insect fauna of Surha Tal, Ballia District, Uttar Pradesh. A total of 29 species of aquatic insects belonging to 20 genera of 14 families and 4 orders were collected during the study. The species *Dineutus spinosus* coming under the Order Coleoptera has the highest value of seasonal abundance. The species *Anisops sardea* belonging to the Order Hemiptera was considered as most abundant aquatic insect species. In Odonata, *Ischnura* sp. was the abundant species. Chironomous larva, *Culex* larva, and Anopheles larva had the higher value in the Order Diptera. This study revealed that the abundance and diversity of aquatic insects showed a greater number in Surha Tal. The monthly percentage abundance of aquatic insect species was *A. sardea*. This was the only insect species present throughout the year. Sarkar *et al*. (2012) reported the morphological and histological data of three digestive glands viz., cephalic, salivary, and accessory glands of the species *Ranatra elongata* Fabricius belonging to the Family Nepidae and Order Hemiptera. This study indicated that the cephalic gland present and always stored in fasting insect for immobilize the prey. The duct of accessory glands was long and well developed with greater diameter. The salivary secretion of *R. elongata* had proteolytic in nature. This was act as capturing the prey and digestion of protein. Joshi (2012) reported the diversity of aquatic heteropterans as indicators of more environmental extremes and their relation to tolerant of some physico-chemical parameters of water. A total of seven families were recorded during the study. This was revealed that the water boatman of

Family Corixidae and the water striders of Family Gerridae can be tolerating more acidic pH. The Giant water bug of Family Belostomatidae can be tolerating low dissolved oxygen, high carbon dioxide, and high chloride concentration. The water strider was also tolerating high turbidity concentration. Among these the other families of water bugs face more difficulty to surviving in the low dissolved oxygen, high carbon dioxide, and high chloride concentration in the aquatic environment. Chandra & Jehamalar (2012a) reported that the new species of aquatic heteropteran bug, *Lathriobates manohardasi* sp. nov. coming under the Family Gerridae from Kanyakumari, Tamil Nadu, India. This study provides the key to all the species of *Lathriobates* of the world. Chandra & Jehamalar (2012b) also suggested the morphological differences between the three species of aquatic heteropteran bugs in the genus *Diplonychus* coming under the family Belostomatidae known from India. The three species of the genus *Diplonychus* viz., *D. annulatus*, *D. molestus*, and *D. rusticus*. The length and width of some morphological differences such as body, head, spiny wing patch, hemelytra, and wing membrane were studied. A total of 27 number of specimens were examined in the species *D. annulatus*, in the case of *D. molestus* it was 206 individuals, and 383 number of specimens were examined in *D. rusticus* during the study. The comparative study of the various morphological characters of those three species were also provided. Some of the morphological characters were similar between the two species of *D. molestus* & *D. rusticus*, and *D. annulatus* & *D. molestus*. The size of the species was different from region to region. The *D. rusticus* was widely distributed across the region in India other than *D. molestus* and *D. annulatus*. The species *D. annulatus* was more restricted distribution in India. Chandra & Jehamalar (2012c) described the species *Ochterus nicobarensis* belonging to the Family Ochteridae and Infraorder Nepomorpha from the Great Nicobar Biosphere Reserve, Andaman and Nicobar Islands, India. This was the second *Ochterus* species identified from India. The detailed description of this species as well as the comparative notes with the other species *O. marginatus* was also provided. Chandra *et al*. (2012a) also revealed the aquatic and semiaquatic heteropteran bugs from Great Nicobar Biosphere Reserve, Andaman and Nicobar Islands, India. The results of the study indicated that overall, 534 individuals collected from this region, and this was comprised of 13 species belongs to 8 genera and 6 families were observed, in which 5

species were recorded for the first time from Andaman Nicobar Islands. The diagnostic characteristics, distributional data, and checklist of aquatic and semiaquatic bugs of this Islands were also provided. Chandra *et al*. (2012b) also described four new records of water bugs such as *Microvelia albomaculata* Distant, *Rhagovelia (Neorhagovelia) sumatrensis* Lundblad, *Rhagadotarsus (Rhagadotarsus) kraepelini* Breddin and *Naboandelus signatus* Distant under the Superfamily Gerroidea from Madhya Pradesh, India. The diagnostic features as well as the distribution of these water bugs were provided in the study. Zettel *et al*. (2012) provided a note on the aquatic bugs of the Family Notonectidae from Southeastern Asia, mostly from Brunei and Philippines. This study revealed that 7 species from Brunei and 21 species from Philippines were recorded. Kour *et al*. (2013) studied the life cycle of *Laccotrephes maculatus* under the Family Nepidae by rearing from egg to adult stages in a laboratory condition from Jammu & Kashmir, India. This study revealed that the life cycle of this species was completed in 50 -70 days. The different stages of immatures of *L. maculatus* were clearly described in the study. Five stages of instars were appeared in the life cycle of this species. Basu *et al*. (2013a) described a new oriental species of water crickets *Velia (Cesavelia) mitrai* classified under the Family Veliidae from Neora Valley National Park, Darjeeling, West Bengal, India. This species was the fourth member of this genus *Velia* identified from India. The detailed description of structure and body measurements of this species was provided. Jehamalar & Chandra (2013a) surveyed the freshwater bugs from the Family Gerridae with the two new species were recorded in South Andaman, India. A total of 6 species of water striders were reported from the study. The six species such as *Limnogonus (L.) fossarum fossarum, Limnogonus (L.) nitidus, Limnometra ciliata, Tenagogonus nicobarensis, Ptilomera (P.) tigrine,* and *Calyptobates andaman*. In which the two species viz., *Limnometra ciliata* and *Ptilomera (P.) tigrina* were reported for the first time from South Andaman. The world-wide distribution of these six species were also provided. Barman & Baruah (2013) worked on the aquatic insects of Kapla Beel, a perennial freshwater wetland of Barpeta District of Assam. This study indicated that 5 Orders of aquatic insects viz. Hemiptera, Coleoptera, Diptera, Odonata, and Ephemeroptera were obtained. Among these Orders Hemiptera was highest number followed by Coleoptera, Odonata, Diptera, and Ephemeroptera. Six families of

Order Hemiptera were observed i.e., Family Belostomatidae, Corixidae, Nepidae, Pleidae, Hydrometridae, and Gerridae. A total of 17 species of aquatic insects were recorded in the Kapla Beel. Basu *et al*. (2013b) described the genus of *Aphelocheirus* belonging to the Family Aphelocheiridae in India and reported the new species namely *A. thirumalaii*. This new species was collected from the Gorumara National Park, Jalpaiguri District, West Bengal. Eight species of the genus *Aphelocheirus* were recorded in India. The three species viz., *A. boukali*, *A. nathani*, and *A. kaygieyess* were represented in the hilly streams of Southern Western Ghats; one species namely *A. narmadaensis* was found in the Central India; and the four species such as *A. thirumalaii*, *A. pradhanae*, *A. signatus*, and *A. pygmaeus*. The systematic key of all the Indian species of *Aphelocheirus* were provided. Ghahari (2013) studied the aquatic and semi-aquatic heteropteran bugs from the regions of Northern Iran, Southern areas of Caspian Sea. A total of 19 species belonging to 5 families of water bugs were reported. The families such as Corixidae, Gerridae, Notonectidae, Hydrometridae, and Saldidae. The general distribution of these species was also provided in the study. Dash (2013) reported the aquatic hemipteran bugs from the Northern estuaries of Odisha, India. A total of 11 species coming under 8 genera and 6 families of aquatic heteropteran bugs were collected from the estuarine habitat. This study revealed that the diversity of aquatic hemipterans was minimum. Gupta & Narzary (2013) studied the aquatic insect fauna of an oxbow lake, Phulbari anua in Cachar District, South Assam, North-East India. A total of 9 species under 9 families and 4 orders of aquatic bugs were collected from the study. The Order Hemiptera was the most diverse insect species found in the lake. In which 5 species belonging to 5 families were recorded from the Order Hemiptera. The status of the dominant species was determined. From the observations of the Engelmann's Scale two species of aquatic insects such as *Anisops lundbladiana* and *Cloeon* sp. were seen eudominant species and this was followed by the subdominant species viz., *Micronecta heliploides*, *Gerris* sp., *Argia* sp., and *Culex* sp. The Shannon Weiner diversity index and Evenness index were indicated that the aquatic insect diversity was low in all the sites. The physico-chemical parameters of the lake were satisfactory in condition, and this was indicated that the water quality of this lake was clean water and non-polluted. According to the correlation coefficient data of aquatic insect community and the water quality

parameters of the Phulbari anua lake was determined that it was mainly governed by the dissolved oxygen, nitrate, and free carbon dioxide concentration. Sitre (2013) studied the bottom dwelling macroinvertebrates and aquatic insects from Ghotnimbala reservoir of Bhadrawati tehsil of Chandrapur District, Maharashtra. This study revealed that the littoral fauna of macroinvertebrates was mainly attached with aquatic weeds. The aquatic coleopterans viz., predacious diving beetles, whirling beetles; and the aquatic hemipterans namely giant water bugs, water scorpions were predominantly found in the littoral zones, and *Hydrometra* sp. and *Ranatra* sp. were observed on the floating sides of the weeds. *Gerris* sp. was found in the surface water. Water boatmen as well as Back swimmers were present in benthic regions of the reservoir. This study was represented the rich diversity and was comprised of one species of Annelida, four species of Mollusca, and a greater number of aquatic insects viz., 9 species of floating and 3 species of bottom dwelling insects. Abhijna *et al*. (2013) reported the diversity of aquatic insect fauna of Vellayani Lake, Trivandrum, Kerala. The distribution pattern of these insects was also provided. A total of 2440 individuals were collected in which 60 species belonging to 37 families and 8 orders were recorded in the lake. The diversity was studied in the five stations of Vellayani Lake. In station 1 represented 33 genera under 23 families and 8 orders while station 2 was founded 44 genera under 26 families and 7 orders; station 3 was denoted by 33 genera belonging to 23 families and 7 orders and station 4 was constituted by 36 genera classified under 23 families and 6 orders. The diversity of aquatic insects in station 5 was 32 genera belonging to 23 families and 7 orders. Among the orders the Order Coleoptera was more diverse in the lake and represented by 22 genera. This study indicated that the abundance of aquatic insects was maximum in station 2 and minimum in station 4. The equal distribution of aquatic insect fauna was found in both station 1 and station 3. The results were showed that the distribution of aquatic insect fauna was greater in Vellayani Lake. Majumder *et al*. (2013) studied on the diversity of aquatic insect community in the three urban freshwater lakes of Tripura, Northeast India. A total of 2159 individuals representing 31 species belonging to 23 genera, 15 families and 4 orders were obtained. From these, the Order Hemiptera and Odonata showed maximum species richness. The three species were reported as first time in this state namely, *Gerris lacustris*, *Diplonychus rusticus*, and

Orthetrum chrysis. The Order Ephemeroptera, Trichoptera, and Plecoptera were totally absent in the three studied freshwater lakes. Devi *et al*. (2013) studied the aquatic and semi-aquatic heteropteran bugs of Loktak Lake of Manipur, Northeast India. This study was seasonally conducted in twelve sites of aquatic habitats. The physical factors were also recorded during the time of collection of aquatic bugs. The seven families of fully aquatic bugs such as Family Corixidae, Belostomatidae, Nepidae, Notonectidae, Naucoridae, Pleidae, and Ochteridae while five families of semi-aquatic bugs viz., Mesoveliidae, Veliidae, Hebridae, Hydrometridae, and Gerridae were collected from the 12 sites. Family corixidae was recorded the most abundant species of water bugs followed by Family Nepidae and Gerridae. This study was determined that the diversity of aquatic bugs was highest in post-monsoon followed by monsoon, pre-monsoon, and winter season. This was also described that the distribution of aquatic and semi-aquatic bugs, their abundance, and biology of each family and species level. Chandra *et al*. (2013) recorded the new species of Hemipterans from Great Nicobar Biosphere Reserve of Andaman and Nicobar Islands in India. A total of 73 species of 57 genera belonging to 26 families were reported. Among these 15 species of 14 genera and 8 families under the Suborder Heteroptera were recorded through survey made in the year 2010 from Great Nicobar Biosphere Reserve, of which 12 species of heteropterans were newly reported and one bug species was identified only up to genus level i.e., genus *Ectomocoris*. Maximum number of species was found from the Family Reduviidae, and this was followed by Family Pentatomidae. Zettel (2013) recorded the two new species of aquatic heteropterans from the Family Hebridae in India. The genus *Neotimasius* was the monotypic genus with the type species of *N. orientalis*. This monotypic type species was documented from the Kerala State, Southern India. This study revealed that the species *N. bruckneri* and *Timasius fenestratus* reported from Madya Pradesh for first time. The species *N. bruckneri* was very closely related with *N. orientalis*. The only differences between the species were the measurements of the body length and width, abdomen length and shape, and length of thorax. The morphological description and body measurements were also provided in the species *T. fenestratus*. Jehamalar & Chandra (2013b) reported the fauna of aquatic and semi-aquatic heteropteran bugs from Chhattisgharh, India. From this study 20 species belonging to 14 genera and 5 families

were represented from nine Districts of Chhattisgharh. The diagnostic characheristics as well as the distribution of those water bugs were clearly described in the study. Jehamalar & Chandra (2013c) described the genus of *Anisops* under the Family Notonectidae from Andaman and Nicobar Islands, India. This study represented by a total of 270 specimens were collected, of which 9 species of the genus *Anisops* were observed. The diagnostic features, distributional data and the photographic plate of species were also provided in the study. Basu *et al*. (2014) described the two new species of aquatic heteropteran bugs under the Family Gerridae from Mahananda Wildlife Sanctuary in the Darjeeling District and from Kalikhola in the Jalpaiguri District of West Bengal, India. The species *Amemboa mahananda* was reported from Mahananda Wildlife Sanctuary while *A. bifurcata* was recorded from Kalikhola of West Bengal. This was revealed the detailed description and structural characteristics of these two new species. The comparative notes on the species *A. mahananda* with *A. speciosa* was also described. Because this species was the close relative of the *A. speciosa*. *A. dentata* was new species found in Himachal Pradesh and *A. kumari* was reported first time in West Bengal. Sundar *et al*. (2014) described three immature stages of the Family Naucoridae from India. This study revealed that the species such as *Helocoris indicus*, *H. vicinus*, and *Pogonaucodina indica* were collected from Tamil Nadu and Karnataka. The diagnostic characters with the help of photographic documentation were also provided. Tara & Kour (2014) reported the morphometric studies and the biology of water bug, *Sphaerodema molestrum* from Jammu and Kashmir, India. The life cycle was studied in the laboratory by rearing from egg to adult. This study described the immature stages of various instars of *S. molestrum.* The total duration of the life cycle of this water bug was completed in 52 – 70 days and five instars were appeared from egg to adult stages. Jehamalar & Chandra (2014) described the two new species of the genus *Hydrometra* coming under the Family Hydrometridae in India. A total of six species namely *H. butleri*, *H. cherukolensis, H. greeni, H. nicobarensis, H. okinawana*, and the unverified *H. bifurcate* were observed from the study. Among these *H. cherukolensis* was the new species obtained from the Kanyakumari District, Tamil Nadu, and *H. nicobarensis* was the second new species collected from the Great Nicobar Island. Basu & Subramanian (2014a) recoded the aquatic and semiaquatic hemipteran bugs from Radhanagari wildlife

sanctuary. This study revealed that 11 adult individuals of water bugs were collected. In which 3 species under 3 genera and 2 families were reported. The reported three species namely *Laccotrephes ruber*, *Cylindrostethus productus*, and *Ptilomera (P.) agroides*. Basu & Subramanian (2014b) also studied the aquatic and semiaquatic bugs from Chandoli National Park. A total of 37 adult individuals were collected from the study area. This study revealed that 6 species of water bugs under 6 genera and 3 families were recorded. The six species of aquatic and semiaquatic hemipterans such as *L. ruber*, *Ranatra elongata*, *Enithares fusca*, *C. productus*, *Ptilomera (P.) agroides*, and *Limnometra fluviorum*. The distribution of these water bugs was also provided. Subramanian *et al*. (2014) described a new species of aquatic hemipteran bug, *Onychotrechus dooarsicus* under the Family Gerridae from Dooars of West Bengal in India. Some of the representatives of this species were collected from the stream in the Buxa Tiger Reserve Forest and this was the seventh species of *Onychotrechus* in India. This *O. dooarsicus* was very closely related with the species of *O. robustus* Anderson from North-western India and *O. jaechi* Zettel & Tran from Bhuttan. The detailed description and key to the all the species of *Onychotrechus* was provided in the study. Jehamalar *et al*. (2014a) reported on the first record of the notonectid species *Anisops tahitiensis* Lundblad from mainland India. This study revealed that this species was collected from the sewage fed pond at Kolkata, West Bengal. Jehamalar *et al*. (2014b) described the two new species of aquatic hemipteran bugs *Pleciobates* classified under the Order Gerridae in India. The new species namely *P. bengalensis* collected from the Jalpaiguri District, West Bengal and *P. expositus* was obtained from Dhubri District, Assam. The morphological characteristics and comparative notes with all allied species were described. A systematic account and distribution map of these *Pleciobates* from India were also provided. Choudary & Gupta (2015) surveyed the aquatic insect fauna of ten selected sites in Deepor beel, Ramsar site of Assam State located on the southern side of Brahmaputra River. A total of 31 species under 26 genera belonging to 18 families and 5 orders of aquatic insects were collected from the study sites. The five orders namely Order Hemiptera, Diptera, Odonata, Coleoptera, and Ephemeroptera. In which the highest number of species was represented in the Order Hemiptera followed by Order Coleoptera. The Order Hemiptera was comprised of 17 species and 8 families. The 8

families of the Order Hemiptera viz., Family Corixidae, Pleidae, Belostomatidae, Nepidae, Notonectidae, Mesoveliidae, Gerridae, and Veliidae. Choudhary & Ahi (2015) published a review report on the biodiversity of freshwater insects. This was indicated that the importance and role of aquatic insects and their abundance in freshwater habitats. These insects were considered as model organisms for analysing the function of the aquatic ecosystems and determining the quality of water. These were indicated the health of the aquatic environment. Saha & Gupta (2015) observed the aquatic and semi-aquatic heteropteran species of three oxbow lakes of Cachar District, Assam and studied the role of these water bugs as biological indicators. A total of 8 families of water bugs were obtained. Among these the Family Corixidae, Notonectidae, Nepidae, Belostomatidae, and Pleidae was the highest number, while Gerridae, Mesoveliidae, and Veliidae was also recorded in the study. The density of aquatic heteropteran bugs in site 1 and 2 was maximum during monsoon period whereas in site 3 was found highest during pre-monsoon period. The different families of these water bugs indicated that the poor to good quality of water. Basu *et al*. (2015a) reported a new record of the aquatic bug species *Metrocoris quynhi* Tran & Zettel from India. This study indicated that this species was collected from the different localities of Bengal and Himachal Pradesh, and this was widely distributed in the Himalayan regions of Bengal. Basu *et al*. (2015b) also described seven new records of aquatic and semiaquatic heteropteran bugs from West Bengal and Odisha. This was revealed that the seven species such as *Ranatra varipes atropha*, *Cercometus pilipes*, *Aphelocheirus (A.) pradhanae*, *Heterobates rihandi*, *Ptilomera (P.) assamensis*, *Ptilomera (P.) agroides* and *Metrocoris communoides* were reported for the first time in India, of which five species were new record from West Bengal and two species from Odisha. The systematic position, diagnostic features and distributional data were also provided.

Mitra *et al*. (2016) reported the new records of six species of aquatic heteropteran bugs from Sundarbans biosphere reserve, West Bengal, India. The six species of water bugs viz., *Lethocerus indicus*, *Diplonychus annulatus*, *D. rusticus*, *Laccotrephes griseus*, *Ranatra digitata*, and *Hydrometra butleri* reported first time from Sundarbans biosphere reserve. These six species coming under the families of Nepidae, Belostomatidae, and

Hydrometridae. A total of 18 species of aquatic hemipterans belonging to 11 genera and 7 families were reported in the Sundarbans biosphere reserve. Among these families, the Family Gerridae represented maximum number of species diversity. The second largest number of species was recorded in the Family Belostomatidae and this was followed by Family Nepidae, Mesoveliidae, Veliidae, Notonectidae, and Hydrometridae. Basu & Subramanian (2016) recorded a new species of *Aphelocheirus (A.) nepalensis* Zettel, 1998 belonging to the Family Aphelocheiridae from Northeastern Himalayan region of India. This species was collected from the Pange stream flowing at the side of the Talley Valley Sanctuary of Arunachal Pradesh. The diagnostic characters as well as the distribution of this species was provided. Basu *et al*. (2016a) described the five new species of semi-aquatic hemipteran bugs from the Family Gerridae in India. The five new species belonging to the genus *Metrocoris* namely *M. murtiensis, M. dinendrai, M. darjeelingensis, M. deceptor, and M. lavitra* were reported in the study. These species were compared to all other *Metrocoris* species with the morphological characteristics of body length, interocular marking, pronotum, fore femora, and genital segment. The identification key as well as the world geographic distribution of all known species of *Metrocoris* were also provided in the study. Dalal & Gupta (2016) revealed an aquatic insect fauna of two different ponds in an urban and rural area located in Cachar District, Assam, India. The comparative study of these two ponds in two seasons based on the diversity of aquatic insects were provided. The urban pond constituted 29 species belonging to 17 families and 5 orders of aquatic insects were found and in rural pond was represented by 17 species of 8 families and 3 orders. Based on the observational results of the Shannon diversity index the maximum abundance was showed in urban pond than rural one. According to the family level biotic indices and physico-chemical properties of these pond ecosystem proved the good water quality in urban pond than rural pond. This study indicated that the urban pond played an important role in the conservation of aquatic insects. Barman & Gupta (2016) studied the fauna of Coleopteran and Hemipteran communities in a small stream, Mauriagaon, this stream flowing through the Chakrashila wildlife sanctuary, Assam, India. The seasonal variation and their abundance of these coleopteran as well as Hemipteran assemblages and the relationship with the environmental factors of the water were also studied. A total of seven species were

reported from the study area. In which 2 species of Order Coleoptera and 5 species of Order Hemiptera were recorded. Among these the three species viz., *Metrocoris nigrofashioides, Ptilomera assamensis*, and *Rhagovelia sumatrensis* were observed throughout the year in the Order Hemiptera while in Coleoptera the only one species i.e., *Orectogyrus* sp. was found. The relative abundance and species density were observed maximum in the Order Hemiptera than the Order Coleoptera. According to the seasonal variation the Shannon Weiner Diversity Index was maximum in pre-monsoon and minimum in post-monsoon. While the Berger – Parker Index of Dominance value was higher in post-monsoon and the Evenness index was greater in monsoon period. The relation between the seasons, environmental variables, and species density were analysed by CCA values. The correspondence between seasons and environmental variables were measured and this value was indicated that a medium to low degree of relationship between season and species. The correlation of species and environmental factors by CCA value were observed high. The abundance of most species was highly depended on the environmental factors of the stream. Basu *et al*. (2016b) worked on the aquatic and semi-aquatic heteropteran bugs of Terai and Dooars region of West Bengal, located in the Himalayan foothills of Darjeeling. A total of 49 species belonging to 30 genera and 13 families of water bugs were recorded from the Terai and Dooars region. *Neogerris parvulus*, *Hydrometra greeni*, *Ptilomera laticaudata*, *P. assamensis*, *Diplonychus annulatus* were the most common species of water bugs observed from the study. Bismi & Pillai (2016) reported the aquatic insect diversity in Karamana river, Southern Western Ghats, India. The collections were made from the seven stations of the river. A total of 833 individuals of aquatic bugs were collected in which 49 species under 47 genera and 28 families of the 7 orders were listed. Among these the Order Hemiptera was the most abundant which was followed by the Order Coleoptera in the Karamana river. The Family Libellulidae under the Order Odonata was the most species rich and the Family Notonectidae belonging to the Order Hemiptera was the maximum number of species was obtained during the study. According to the station wise abundance of aquatic insects in the river the station 1 showed maximum diversity and minimum were observed in station 7. Shannon diversity index revealed that all the stations showed more aquatic insect community instead of station 4. The evenness index indicated the aquatic insects

were more evenly distributed in the station 4 and station 7. This study revealed that the diversity and abundance of aquatic insect fauna was maximum in the Karamana river thereby indicated the quality of water and this river was non-polluted. Basu *et al*. (2016c) also studied a case study of aquatic hemipterans as potential bioindicator of wetland ecosystems of Himalayan and Sub-Himalayan regions of West Bengal, India. A total of 47 species of aquatic and semi-aquatic heteropterans were obtained. *Diplonychus annulatus, Rhagovelia* sp.*, Ranatra varipes varipes, R. varipes atropha, Mesovelia vittigera, Hydrometra greeni, Heterobates rihandi, Chimerrhometra orientalis, Ptilomera laticaudata,* and *P. assamensis* were dominated in polluted sites. Whereas *Amemboa Mahananda, Gerris nepalensis, Enithares* sp. and *P. himalayensis* were represented in clean non-polluted sites. These water bugs represented the health of the aquatic ecosystem and water quality. Basu *et al*. (2016d) also reported an overview of biomonitoring potential of aquatic insects in freshwater ecosystems. This was revealed that a few species of aquatic and semiaquatic hemipteran bugs act as a good bioindicators for water quality. Jehamalar & Chandra (2016) revealed an additional record of aquatic and semiaquatic heteropteran bugs from Chhattisgarh, India. This was represented that a total of 20 species were recorded earlier in 2013 and this study reported an additional of 17 species under 12 genera and 9 families from seven Districts and five protected areas of this region. Overall, 37 species were recorded from Chhattisgarh, India. Chandra *et al*. (2017a) described the status of the diversity of freshwater fauna in India. This report was well defined as the Indian freshwater habitats and the faunal diversity, and various kinds of Indian wetlands. A total of 9456 species were represented in the freshwater ecosystems of India. Among this invertebrate groups the Phylum Arthropoda was alone represented as 5923 species in total. The most diverse class of freshwater insects was estimated as 4842 species. The aquatic bug species was represented by 325 species belonging to 84 genera, 18 families and 3 infraorders of Suborder Heteroptera in India. This report was also mentioned the knowledge gaps of the diversity and abundance of freshwater organisms as well as the threats to the fauna of freshwater habitats in India. Basu & Subramanian (2017) described a report on the aquatic hemipteran bug fauna in India. The fossil history and historical resume of aquatic Hemiptera was described. A total of 325 species belonging to 84 genera were reported in India. The Infraorder Gerromorpha and

Nepomorpha were widely distributed in freshwater ecosystems. But many families of the Order Leptopodomorpha were found in high altitudinal regions. This report was also revealed that the distribution, endemism, biology, lifecycle, life span, threats, conservation and significance, gaps in research, and future dimensions of aquatic hemipterans. Gupta & Sharma (2017) studied a detailed description of the all the species under Family Veliidae from different Zoogeographical regions of India and the distributional range of those species were also provided. Basu *et al.* (2017a) recorded a new species of *Eotrechus fuscus* sp. nov. under the Family Gerridae from Sikkim, India and *E. longipes* was reported for the first time from this region. This study revealed that a total of 6 species of this genus was reported from India with the addition of this new species. This was provided the identification key to all the known species of this genus from India. Basu *et al.* (2017b) also described a morphological and molecular characterization of COI gene of the aquatic gerrid species *Limnometra fluviorum* Fabricius. The molecular approach of this species was reported for the first time from India. The structural characters and distributional data were also given in the study. Bismi & Pillai (2017) studied a DNA Barcoding and molecular phylogeny of some aquatic heteropteran bugs in Shola Forest, Southern Western Ghats, Kerala. The COI gene of 7 aquatic bug species such as *Anisops paranigrolineatus* Brooks and *Enithares hungerfordi* Brooks belongs to the Family Notonectidae, *Helocoris rotundatus* Montandon under the Family Naucoridae, *Perittopus horvathi* Lundblad from the Family Veliidae, *Metrocoris indicus* Chen & Nieser and *Limnometra anadyomene* Kirkaldy from the Family Gerridae, *Sigara (Tropocorixa) graveleyi* Hutchinson under the Family Corixidae, were sequenced and studied the genetic diversity of these bugs. The phylogenetic relationships of seven aquatic bugs were analysed. This was the first molecular study of these seven aquatic bug species in Shola Forest. Jehamalar *et al.* (2018a) studied the water striders of the genus *Cylindrostethus* Mayr from India. This study revealed that a gerrid species *Cylindrostethus costalis costalis* Schmidt was reported for the first time from India and a detailed study was made of the male and female genitalia of this genus known from India. Basu *et al.* (2018a) reported a new species *Metrocoris sikkimensis* sp. nov. belongs to the Family Gerridae from Northeast India. The identification key as well as the distributional map of this species from India were also provided. The comparative study of this species

with *M. nepalensis* was made in the study. Jehamalar *et al*. (2018b) recorded a new species of the genus *Helotrephes* and first report of the species *Tiphotrephes indicus* Distant from India. The new species *H. nainamalaii* sp. nov. was observed from Meghalaya. The identification characters of these species as well as the checklist of the Family Helotrephidae in India were also provided in the study. Basu *et al*. (2018b) studied a morphological and molecular characterization of selected predatory aquatic and semiaquatic bugs of India. This study revealed that a total of 8 species such as *Laccotrephes griseus* from the Family Nepidae, *Amemboa kumari*, *Chimarrhometra orientalis*, *Ptilomera (P.) himalayensis*, *Ptilomera (P.) agroides*, *Metrocoris dinendrai*, *M. deceptor* from Family Gerridae, and *Hydrometra greeni* from Family Hydrometridae were identified based on both morphological characters and mitochondrial cytochrome oxidase I (COI) gene. Kumar & Gupta (2018) described the external morphology of Indian water bug species *Micronecta striata*. This study revealed that the characteristic features of this species was provided in detailed with the help of photographic plates. Jehamalar *et al*. (2018c) reviewed a water strider Subgenus *Ptilomera* from India and described a new species of *Ptilomera (P.) nagalanda* Jehamalar & Chandra sp. nov. This new species was observed from Peren District, Nagaland, India. Distributional map as well as the identification key of all the known species from India of this genus were also given in the study. Basu *et al*. (2018c) provided a monograph of water bugs of Himalayan and Sub-Himalayan regions of West Bengal, India. This study revealed that a total of 61 species under 34 genera and 14 families from these regions of West Bengal. This study provided the detailed description of characters with photographs. The taxonomic key as well as the distributional map of these species were also documented. Saha & Gupta (2019) surveyed the aquatic hemipteran community in the Agricultural fields of Barak Valley, Assam, Northeast India. This study represented a total of 30 species coming under 19 genera and 11 families. The data was analysed with the help of diversity indices such as Shannon Wiener index, Evenness index and Berger Parker index. Singh & Shoeb (2020) studied a general description of the back swimmers from the Family Notonectidae with the endoskeleton of head region. This study revealed the life stages and behaviour of the notonectid species *Notonecta glauca*. Saha *et al.* (2020) revealed the lentic biodiversity of aquatic insects as well as the spiders of two freshwater ponds of

Narendrapur, West Bengal. This study compared the biodiversity of managed and unmanaged ponds. This study reported that the three species of water bugs such as *Enithares ciliata*, *Plea liturata* and *Ranatra filiformis* were recorded from managed pond and nine species namely, *Diplonychus annulatum*, *E. ciliata*, *Laccotrephes maculatus*, *Limnogonus fossarum*, *Mesovelia vittigera*, *Micronecta (Basilonecta) scutellaris scutellaris*, *Mesovelia diluta*, *P. liturata* and *R. filiformis* were observed from unmanaged pond. Jehamalar & Chandra (2020) reported new records of aquatic and semiaquatic hemipteran bugs from mainland India. A total of 4 species such as *Anisops occipitalis* Breddin, *Hydrometra okinawana* Drake, *Neoalardus typicus* Distant and *Limnometra ciliata* Mayr were collected from different Districts of Meghalaya, India. This study revealed that these four species were found very rare in this region. The diagnostic characters as well as the distributional date were also given in this study.

Zettel & Laciny (2021) described the taxonomy of aquatic hemipteran bugs of some unusual Microveliinae from the Family Veliidae from India. Three new species as well as the two new genera were reported. *Thirumalaia ocularis* gen. nov. & sp. nov. was reported from the Tamil Nadu, *Geovelia fikaceki* sp. nov. from Arunachal Pradesh, and *Eyarinella robusta* sp. nov. from Kerala and Tamil Nadu. This study provided the taxonomic key and the checklist of all the genera of Subfamily Microveliinae from India. The species *Neoalardus typicus* Distant, 1903 was recorded for the first time in Rajasthan, India. Lyngdoh *et al*. (2021) also studied the aquatic and semiaquatic hemipteran bugs of Rajasthan, India. This study recorded based on the perusal of literature and the collection of water bugs from this region. A total of 34 species belongs to 19 genera and 10 families were reported from Rajasthan. Attawanno & Vitheepradit (2022) studied the species composition of aquatic (Nepomorpha) and semiaquatic (Gerromorpha) heteropteran bugs in Kaeng Krachan National Park, Thailand. This study revealed that a total of 60 species belongs to 33 genera and 11 families of water bugs were observed. Highest number of families were found in the Infraorder Nepomorpha, and higher species richness was observed in the Infraorder Gerromorpha.

2.3 Materials and Methods

2.3.1 Study area

The investigation was done from the year 2016 to 2020. The water bugs were collected from the 14 Districts in Kerala (Fig. 1). The map of study area of Kerala was generated by using 'QGIS' software. Table 1 shows that the various kinds of aquatic habitats were selected for the study and the photographs of selected aquatic habitats were also included (Plate 2 & 3: Fig. 5a-5l). The geographical coordinates such as longitudes and latitudes were taken by using the mobile application, Ulysse Gizmos Version 1.6.2. The collection of aquatic and semi-aquatic heteropteran bugs was made in a total of 109 locations from the different habitats. The collection sites and their details were provided in the Appendix 1.

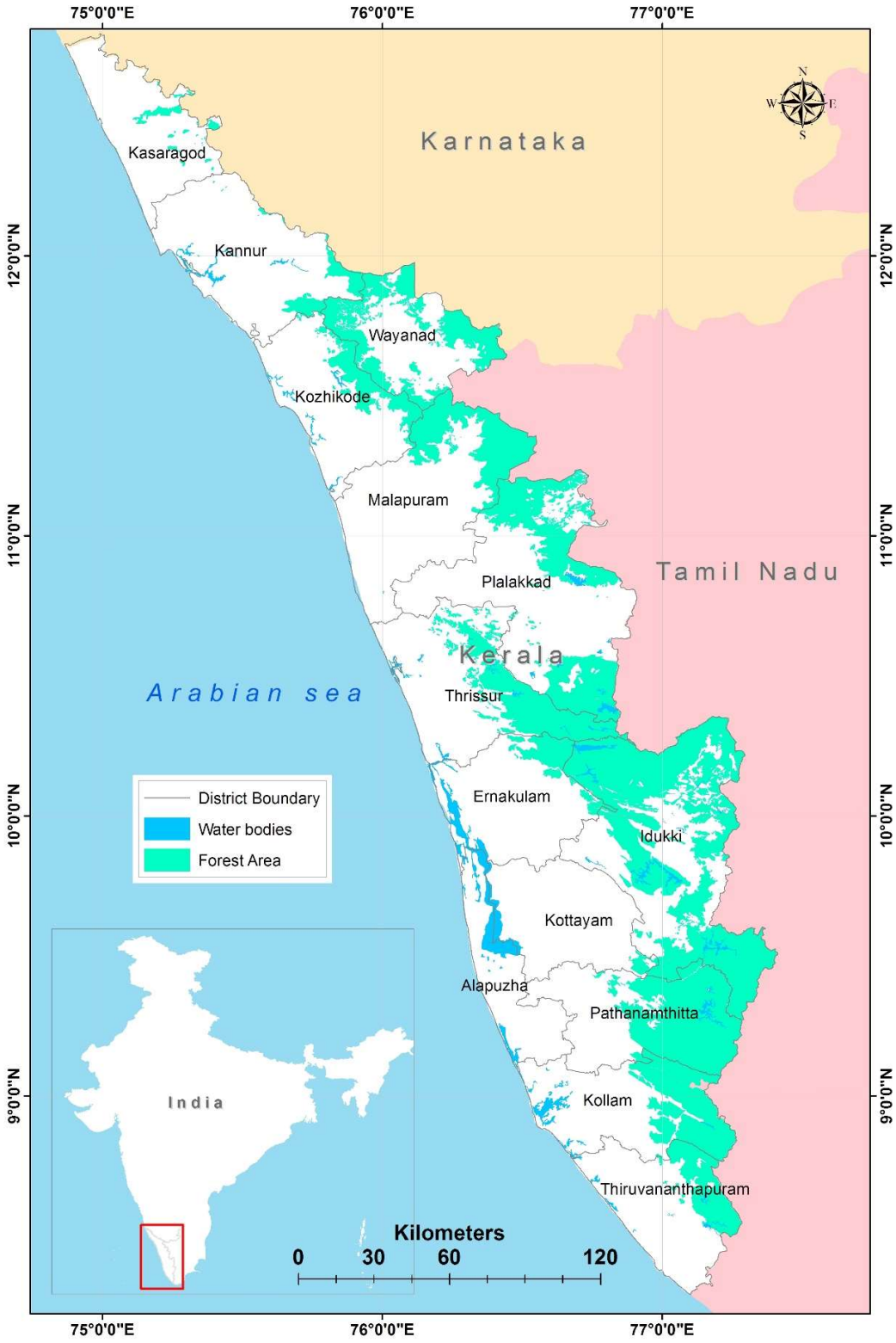

Figure 1. Map of the study area of 14 Districts of Kerala.

Table 1. Different types of aquatic habitats selected for the study.

SL. NO.	AQUATIC HABITATS
1.	Rivers
2.	Ponds
3.	Waterfalls
4.	Forest streams
5.	Torrential streams
6.	Quarry & rock pools
7.	Irrigation canals
8.	Agricultural fields & Kole wetlands
9.	Lakes (including dams, check dams, & regulators)
10.	Backwaters
11.	Mangroves
12.	Man-made pools

2.3.2 Sample collection and preservation

The water bugs were collected by using simple random sample method. Various methods were used for the collection of these bugs (Plate 4: Fig. 6a-6f), which includes:

1. Hand picking method (Fig. 6e),
2. Using aquatic insect net (500 µm mesh sized D- Frame dip net) (Fig. 6a-6d),
3. Using aquarium net (Fig. 6f), and
4. Using Small sieves.

Water bugs sampling were done from the different microhabitat for one hour at each site to standardise sampling per collection site. Morning hours (before 11 am) and late noon hours (after 4 pm) was fixed for collection since the bugs were noted to clinging on the rootlets of aquatic vegetation. A good number of water bugs were collected for the identification purposes. The photographs of aquatic habitats were taken by using Nikon digital camera as well as the Samsung mobile phone. Some species of water bugs were attracted to light, and they were observed nearby the aquatic habitat. Thus, they were also collected from light.

After the collection of water bugs, all the collected specimens were sorted, and they were transferred to air tightened bottles and vials containing 70% alcohol as preservatives for identification (Plate 5: Fig. 7a-7c). They were properly labelled with the collection date and place. The methodology was based on the field guide of Subramanian & Sivaramakrishnan (2007a, 2007b) and was used for the collection and sorting of the specimens.

2.3.3 Identification of specimens

It brought back to laboratory and observed under both dissection and stereo-zoom microscopes. The photographs and measurements were taken in stereo-zoom microscopes such as LEICA S8AP0 and LEICA EZ4E. All the collected samples were identified at species level with the help of standard taxonomic keys, monographs, identification manuals and published literature (Thirumalai, 1986; Thirumalai & Radhakrishnan, 1999;

Nieser, 2004; Stearns & Krieger, 2008; Chandra & Jehamalar, 2012b; Chandra *et al.*, 2012a, 2012b; Bal & Biswas, 2013; Basu *et al.*, 2014a, 2014b, 2015b, 2016b, 2018a, 2018c; Jehamalar *et al.*, 2014; Jehamalar & Chandra, 2013a, 2013b, 2013c, 2020; Zettel & Laciny, 2021). From the samples, the males and females were separated and mostly the male specimens were used for the species identification. The male abdominal part was dissolved in 10 % KOH solution for 24 hours and then the genitalia was dissected for the confirmation of species. This was followed by the dissection method of Padwal *et al.* (2018).

2.4 Results

A total of 65 species belongs to 34 genera and 14 families of three infraorders were recorded from this study. These 65 species were taxonomically described (Plate 6: Fig. 8 to Plate: 38: Fig. 72) and the locations were mentioned as legends in Appendix 2. The systematic account of total 65 species was given in Appendix 3.

2.4.1 TAXONOMIC DESCRIPTION OF 65 SPECIES

INFRAORDER NEPOMORPHA

Family Nepidae

Cylindrical or flattened body. The body size varies from 15 mm to 50 mm. Long and slender appendages. Raptorial forelegs. Ocelli absent. Single segmented tarsi. Very long non-retractile breathing siphon originated from the eighth abdominal tergite.

1. *Laccotrephes griseus* Guerin-Meneville, 1844

(Plate 6: Fig. 8a-8c)

Material examined: 11 ♂; 6 ♀; 8 Nymph; Coll: S. Ranjini.

Diagnostic characters: Body small, hard, elongate, and light brown in colour and the length varies from 15 mm to 20 mm. Head triangular, directed forward and the length of 1.8 mm and 1.1 mm in width. Eyes small and oval, located at the apex. Sharp, stout, and thick rostrum. Three segmented antennae hidden inside the posterior part of the head. The tiny hairs present on the antennae. Rectangular shaped pronotum and the length of 2.4 mm. Scutellum triangular. Abdomen more flattened and 12 mm in length. Wings thick and parallel. Numerous reticulate veins present on the hemelytra. Abdominal appendages shorter than the body length. Raptorial foreleg with sharp claws. The base of the fore femur with a rounded tooth. A pair of respiratory siphon present and 13 mm in length, always shorter than body (Fig. 8c). The male parameres symmetrical and slightly hook shaped.

Locations: KAU, TRK, KJK, WAL, MLP, KLY, ESW, and MVL.

Habitats: Pond, lake, river, and agricultural fields.

Remarks: Mostly observed under the muddy bottoms of the aquatic habitat with mass aquatic vegetation, edges of water body, under the water surface and sometimes attached to the aquatic vegetations like grasses and water hyacinth. This species was found both shaded and nonshaded areas. This was predatory in nature and feed on small to medium sized invertebrates. This was widely distributed and previously known from Kerala (Jayakumar & Mathavan, 1985).

2. *Laccotrephes ruber* Linnaeus, 1764

(Plate 6: Fig. 9d-9f)

Material examined: 16 ♂; 8 ♀; 4 Nymph; Coll: S. Ranjini & C. Selvarajan.

Diagnostic characters: Brownish-coloured body and length from 30 mm to 35 mm and the width of 8 mm. Head triangular and protruded forward. Three segmented antennae hidden inside the posterior part of the head. The tiny hairs present on the antennae. Anteriorly the prosternum convex shaped with a small, an indistinct tubercle. Abdominal

appendages slightly longer than the body length. Respiratory siphon stout and very longer than body (Fig. 9f). The male parameres curved and hook shaped.

Locations: AAU, KOU, THR, KUL, VLA, ERA, TRK, WAL, MLP, KLY, KUU, TKS, and MVL.

Habitats: Rock pools, ponds, irrigation canals, agricultural fields, quarry pools, lakes, and river.

Remarks: Mostly observed in stagnant waters, slow flowing water bodies, the muddy bottom of rice fields, and gaps in the aquatic vegetations. This species was observed both shaded and nonshaded areas of water ecosystems. This was well known predator, slow movers and previously recorded from Kerala (Thirumalai & Radhakrishnan, 1999).

3. *Cercotmetus pilipes* Dallas, 1850

(Plate 7: Fig. 10a-10c)

Material examined: 6 ♂; 1 ♀; 1 Nymph; Coll: S. Ranjini.

Diagnostic characters: Light, brown-coloured body and length from 40 mm to 41 mm. Large, wide, and globular eyes. Tubercle present on the vertex of the head. Head length 1.95 mm and width 1.26 mm. Rostrum 2.43 mm, sharp and stout. Small sized dark coloured antennae, hidden inside the head posteriorly. Thorax wide and prominent scutellum. Fore wings not reaching at the end of the abdomen. Fore femora always shorter than pronotum. Dark, yellowish-coloured long hairs present both sides of the tarsi, mid and hind tibia. Light yellow coloured broken stipes on legs (Fig. 10c). Respiratory siphon very short and four times smaller than body. The length of breathing tubes 10 mm.

Locations: MUM, ADI, OOA, PAI, NUI, and KDY.

Habitats: Forest streams, pond, irrigation canals, river, agricultural fields, and man-made pools.

Remarks: This species was cosmopolitan in distribution. Mostly observed in the inner sides of aquatic vegetations like grasses, *Azolla* sp. and water hyacinth. This was found in nonshaded areas. This was mostly seen in the forest streams and rivers. This was previously known from Kerala (Thirumalai & Radhakrishnan, 1999).

4. *Ranatra varipes atropha* Montandon, 1903

(Plate 7: Fig. 11d-11g)

Material examined: 6 ♂; 1 ♀; 3 Nymph; Coll: S. Ranjini.

Diagnostic characters: Brownish-coloured and long body, length from 18.5 mm to 23 mm. Red and globular eyes. Head length 1.45 mm and width 0.83 mm. Rostrum long, slender and length of 1.8 mm. Small, dark and three segmented antennae on the ventral side of the head. The second and third antennae dark in colour and stout hairs distributed over (Fig. 11e). Anterior part of pronotum greater than the posterior region. Prosternum with a distinct keel on the ventral side. Prominent median keel present on the meso-sternum. Meta-sternal keel little bit bulged and V-shaped (Fig. 11f). Fore femora broader and distinct tooth present (Fig. 11g). Light yellow coloured broken stipes on the fore femora (Fig. 11g). Fore tarsi little curved. Hind femora long and reaching up to the sixth abdominal sternite. Respiratory tube usually shorter than body and the length of 14 mm.

Locations: KIY, MPK, MLR, NUI, KAN, and ELM.

Habitats: Pond, man-made pools, and agricultural fields.

Remarks: This species can be found with mass aquatic vegetation like Azolla sp. This bug species was seen in the shallower regions, edges, and sunshade areas of water ecosystems. This species was rarely found species in the aquatic habitat. This bug species reported earlier from West Bengal, Assam, Karnataka, Bihar, Madhya Pradesh, Tamil Nadu, and Pondicherry (Basu *et al.*, 2018c), but this was the new record from Kerala.

5. *Ranatra varipes varipes* Stal, 1861

(Plate 8: Fig. 12a-12d)

Material examined: 2 ♂; Coll: S. Ranjini.

Diagnostic characters: Body yellowish brown and the length from 19 mm to 20 mm. The length of head longer than the interocular length. Vertex rounded. Pronotum longer, 1.4 mm in length and with a prominent ridge at the posterior angle of each side. Globular eyes located on the lateral sides of the head. Rostrum slender. Three segmented antennae. The second and third antennal lobes fringed with numerous stout spines (Fig. 12b). Hemelytra extending up to the abdomen. Meta-sternum blunt and slightly rounded at the posterior end and flat in appearance with no lateral concavity and mid longitudinal carina less distinct (Fig. 12c). Meso-sternum rounded with a V-shaped cleft. Abdominal appendages long and about 12 mm to 13 mm in length. Fore femora broad with irregular brown markings and provided with a distinct tooth (Fig. 12d). Fore tibia longer. Hind femora reaching beyond the sixth abdominal sternite. Respiratory siphon 12 mm in length and often shorter than the body.

Location: POA.

Habitat: Lakes.

Remarks: This species was collected from un-shade shallower regions of lake covered with Indian lotus, *Nelumbo nucifera* plants. This was found in between the plants. This was reported from various regions of India such as Maharashtra, Bihar, Meghalaya, Manipur, Tamil Nadu, Odisha, West Bengal, Pondicherry, and Uttar Pradesh (Basu *et al.*, 2018c). This was the new report from Kerala.

6. *Ranatra filiformis* Fabricius, 1790

(Plate 8: Fig. 13e-13g)

Material examined: 12 ♂; 6 ♀; 14 Nymph; Coll: S. Ranjini.

Diagnostic characters: Light brownish body, length from 27 mm to 28 mm. Head 1.35 mm in length and width of 0.9 mm from the anterior apex. Head provided with a distinct tubercle on the vertex. Eye wider and globular and length of 0.65 mm. Sturdy and sharp rostrum and the length of 0.9 mm. The interocular space wide and the width 0.76 mm. The antennae short, three segmented and inserted behind the head. The second and third segments of antennae dark in colour fringed with stout spines (Fig. 13f). Pronotum long and distinct. The anterior lobe of the pronotum slightly darker and longer than the posterior lobe. Scutellum short and prominent. Prothorax with a projecting keel on the ventral side. Mesosternum round and metasternum distinctly broader (Fig. 13g). Abdominal appendages long and about 23 mm in length. Fore femora longer and a length of 7 mm with a stout spine. The light and dark coloured band annulated with both the femoral and tibial segments of mid and hind legs. Respiratory siphon slender and 22 mm in length. The male parameres distally hook shaped with numerous small spines on the inner margins.

Locations: VEI, AMH, ALE, ALR, KUL, VLA, KAR, PEM, KPM, UPM, YKA, MPK, NUI, WAL, OLY, KLY, KUU, and TMM.

Habitats: Lake, pond, irrigation canals, man-made pools, quarry pools, agricultural fields, and rivers.

Remarks: This bug species was cosmopolitan in distribution and commonly found. This was observed in the edges and roots of aquatic vegetations and seen in both shaded and nonshaded areas. This was abundantly observed in the lakes and ponds. This was previously reported species from Kerala (Kumari & Nair, 1984).

7. *Ranatra elongata* Fabricius, 1790

(Plate 9: Fig. 14a-14c)

Material examined: 2 ♂; Coll: S. Ranjini.

Diagnostic characters: Body large, cylindrical, very elongate and the body length from 40 mm to 45 mm in size. Brownish yellow in colour. Hemelytra slightly dark brown. Eyes black and spherical. Abdominal appendages very longer than the body and about 50 mm to 55 mm in length. Meta-sternal process sub-triangular in shape with longitudinal groove centrally. Fore coxae very long (Fig. 14c). The length of anterior lobe of prothorax less than the length of posterior lobe. Fore femur with a large triangle-shaped tooth beyond the middle. Respiratory siphon two times longer than body.

Location: ADI.

Habitat: Forest streams.

Remarks: This species was found in forest streams with stagnant waters. This was found near the aquatic vegetations and sunshade areas. This was widespread species across India and previously studied from Kerala (Thirumalai & Radhakrishnan, 1999).

Family Belostomatidae

Body size of this giant bug varies from 10 mm to 110 mm. The flattened body and brown or dark brown in colour. Two short and straight respiratory tubes present at the last abdominal segment.

1. *Diplonychus molestus* Dufour, 1863

(Plate 9: Fig. 15d-15f)

Material examined: 14 ♂; 2 ♀; 5 Nymph; Coll: S. Ranjini & C. Selvarajan.

Diagnostic characters: Body brown, length from 15.5 mm to 17 mm and width from 9 mm to 10 mm. Head long and the apex of head blunt. Head length 1.2 mm and width 4.2 mm. Pronotum broad and the angle more obtuse posteriorly (Fig. 15e). Fore tarsi one segmented. Hemelytra longer than broad. Large wing membrane, extended to the inner margin. Spiny patch of corium almost round and the inner apex of corium inwardly

curved. Respiratory tube straight and without cluster of setae (Fig. 15f). Male paramere almost straight.

Locations: ARA, VEI, KAA, WDY, THR, KAU, ALE, KUL, PEM, CMA, NUI, VAR, ELM, and MVL.

Habitats: River, lake, forest streams, man-made pools, pond, irrigation canals, and agricultural fields.

Remarks: This species was cosmopolitan in distribution and found near the aquatic vegetations such as grasses and roots of water hyacinth. This was numerously observed in ponds and lakes. This was found on both shaded and nonshaded part of aquatic ecosystems. This was previously recorded from Kerala (Thirumalai, 2007).

2. *Diplonychus rusticus* Fabricius, 1781

(Plate 10: Fig. 16a-16c)

Material examined: 22 ♂; 9 ♀; 7 Nymph; Coll: S. Ranjini.

Diagnostic characters: Brownish-coloured, small, elongated, sub-oval body, length from 15 mm to 17 mm. Blunt at the tip of the head and absence of ocelli. Less acute pronotum angle on the posterior part. Head length 1.2 mm, shorter than the interocular space and width of 3.9 mm. Median longitudinal groove on the vertex. Wing membrane smaller and extended up to the inner edge. Spiny patch of corium oblong. Hemelytra length 12 mm and width 5.2 mm. Broader hind wings. Short legs. Fore tarsi single segmented. Hind leg not extending beyond the tip of the abdomen. Distinct lines present on the abdominal sternum. The breathing tubes possesses cluster of setae (Fig. 16c). Male paramere curved.

Locations: THD, VEI, KOA, POA, THR, AMH, KAU, PAI, ALE, ALR, KUL, VLA, PEM, UPM, CMA, YKA, AGT, MLR, NUI, KAN, OLY, KLY, KUU, ELM, TKS, ESW, and MVL.

Habitats: Irrigation canals, lake, pond, agricultural fields, river, and quarry pools.

Remarks: This species was very common and widely distributed. This was mostly found in the edges of the water bodies. Although, they were seen in both shaded and nonshaded areas. This was numerously seen in the ponds, lakes, and quarry pools. This was previously known from Kerala (Thirumalai & Radhakrishnan, 1999).

3. *Lethocerus indicus* Lepeletiler & Serville, 1825

(Plate 10: Fig. 17d-17f)

Material examined: 2 ♂; 1 Nymph; Coll: S. Ranjini & C. Selvarajan.

Diagnostic characters: The largest bug species, elongate, dorsoventrally flattened and narrowly oblique body (Fig. 17d). Body length from 65 mm to 90 mm and width of 35 mm. Head blunt and eyes in front of the head on the apex part and length of the head up to 1.25 mm and width of 4 mm. Eyes large and wider. Antennae very short and hidden inside the groove on the ventral side. Stout and very sharp rostrum and length of 2.8 mm. Interocular part 1.5 mm. Eye length 1.3 mm. Pronotum wider and broad scutellum. Hemelytra with distinct longitudinal veins. Fore legs raptorial and stronger to hold larger prey (Fig. 17f). Fore femur longer and length of 7.35 mm, width 2.93 mm. Fore tibia longer than mid tibia with sharp claws. Bunch of swimming hairs present on the ventral side of mid and hind legs. Genital segments more elongated and a pair of retractable and strap-like short respiratory tubes.

Locations: KAU, and KDM.

Habitats: Pond, and agricultural fields.

Remarks: This species was very wide in distribution and predacious in nature. This was seen mostly in the edges of agricultural fields and the inner sides of aquatic vegetation. This was found in both shaded and nonshaded areas of water ecosystems. This was previously known from Kerala (Thirumalai & Radhakrishnan, 1999).

Family Corixidae

The body size of corixid bugs ranges from 1.8 mm – 16 mm. The tarsus of fore-legs single segmented and scoop-shaped. Exposed or obscured scutellum and irregular abdominal segment.

1. *Sigara (Vermicorixa) kempi* Hutchinson, 1940

(Plate 11: Fig. 18a-18c)

Material examined: 3 ♂; Coll: S. Ranjini & C. Selvarajan.

Diagnostic characters: Body long, elongate and the length of 6.5 mm. Head protruded in front between the eyes and yellow in color. Blackish brown pronotum with yellow transverse lines present, the first and last two stripes straight and steady. Pro-notal disc posteriorly rounded. Lateral lobes of prothorax with concave margin on dorsal and ventral sides. Clavus with three steady and straight yellow lines present. Corium with crosswise yellow lines. Vertex with a low vague longitudinal carina present on the posterior part. Hind femur long and reaching beyond the centre of the midline, outer margin with three spines. Fore femur with developed stridulatory combs present (Fig. 18c). A small strigil observed on the sixth abdominal segment.

Locations: ALE, and YKA.

Habitats: Pond and river.

Remarks: This species was very rare and found with mass aquatic vegetation such as *Azolla* sp. This was observed in the nonshaded part of water bodies. This was poorly known one and reported only from Arunachal Pradesh, Himachal Pradesh, Sikkim, Meghalaya, West Bengal, and Uttar Pradesh (Basu *et al.*, 2018c). This water bug species was new record from Kerala and first report from South India.

2. *Sigara (Tropocorixa) promontoria* Distant, 1910

(Plate 11: Fig. 19d-19f)

Material examined: 2 ♂; Coll: S. Ranjini & C. Selvarajan.

Diagnostic characters: Body length 6.18 mm. Head length 0.452 mm, width 0.71 mm. Head roundly protruded in front of the eyes. Pronotum dark black with six yellowish oblique lines. Length of pronotum 0.97mm, width 1.71 mm. Vertex with rows of ambiguous perforations present throughout the posterior half. Eye length 0.91 mm and width 0.36 mm. Clavus black with narrow, broken, and irregular yellow transverse markings present. Few long swimming hairs found on the mid femur. Fore femur with two pairs of small spines on distal region (Fig. 19f). A well-developed median lobe present on the seventh segment and its apex of connexivum consists of a small projecting lobe. Strigil temperately large and consists of seven combs.

Location: ALE.

Habitat: Pond.

Remarks: This species was observed in pond almost covered with *Azolla* sp. This was observed in nonshaded areas and very rarely found. This was widely distributed in Delhi, Bihar, Karnataka, Odisha, West Bengal, Punjab, Rajasthan, and Uttar Pradesh (Basu *et al.*, 2018c). This was the new report from Kerala.

Family Micronectidae

Micronectid bugs very resemble to the Family Corixidae and very small sized bugs. The body size ranges from 1 to 4 mm. Exposed scutellum. Antennae three segmented.

1. *Micronecta scutellaris scutellaris* Stal, 1858

(Plate 12: Fig. 20a-20c)

Material examined: 12 ♂; 4 ♀; 2 Nymph; Coll: S. Ranjini.

Diagnostic characters: Large and elongate body and length from 3.6 mm to 4 mm, greyish brown colour. Head protruded in front and bluntly located. Dark longitudinal lines present on the hemelytra and dark brown patches on it (Fig. 20c). Longitudinal stripes vary from unbroken to broken ones. Abdominal segments asymmetrical.

Locations: CHY, THR, KAU, PEM, THK, UPM, YKA, ANM, BYM, CHA, and ESW.

Habitats: River, pond, irrigation canals, agricultural fields, and backwaters

Remarks: This species was observed in both shaded and nonshaded areas. This was found abundantly in the edges of ponds, lakes, and backwaters. This species was cosmopolitan in distribution and previously reported from Kerala (Thirumalai & Radhakrishnan, 1999).

2. *Micronecta quadristrigata* Breddin, 1905

(Plate 12: Fig. 21d-21f)

Material examined: 27 ♂; 4 ♀; 5 Nymph; Coll: S. Ranjini.

Diagnostic characters: Body is light brown and elongated. Body length from 2.6 mm to 2.9 mm and width of 1.2 mm. Head dull yellow with one light reddish longitudinal stripe on vertex. Head length 0.25 mm and width 0.65 mm. Interocular width 0.37mm. Eye length 0.41 mm and width 0.13 mm. Brown coloured pronotum, length 0.93 mm and width 0.35 mm. Length of wings 2.26 mm. Broken longitudinal lines present on the hemelytra. Lateral margins of hemelytra with four black patches (Fig. 21f). Elongated and large patch present on the basal part. Strigil present on the left and the free lobe of eighth tergite observed on the right side.

Locations: ARA, PEI, ATY, CHY, AYA, PIA, MAM, THR, KAI, PEM, TRK, CMA, NLY, KJK, NUI, WAL, MLP, ELM, AYD, MNR, CHA, and ESW.

Habitats: River, irrigation canals, agricultural fields, pond, lakes, Kole wetlands, and backwaters.

Remarks: This species was very common and abundant in the edges of ponds, lakes, agricultural fields, and rivers. This was found in both shaded and nonshaded part of water bodies. This was distributed across India (Basu *et al.*, 2018c) and reported from Kerala (Thirumalai & Radhakrishnan, 1999).

3. *Micronecta haliploides* Horvath, 1904

(Plate 13: Fig. 22a-22c)

Material examined: 5 ♂; 5 ♀; 1 Nymph; Coll: S. Ranjini.

Diagnostic characters: Large, oval shaped and elongated body. Body light yellowish in colour and length varies from 2.4 mm to 3.4 mm and width of 0.9 mm. Head narrow and long, yellowish and length of 0.35 mm and width of 0.51 mm. Vertex convex or rarely flattened without any impression. Interocular length 0.43 mm and eye length 0.34 mm. Interocular width and eye width almost same as 0.23 mm. Pronotum very wide than head and transverse. Pronotum dark in colour with very short lateral margins. Scutellum dark brown colour and yellowish margins in below. Wings pale yellow and black coloured spots present on the yellow-coloured hemelytra (Fig. 22c). The surface of hemelytra smooth. Broken brown longitudinal markings present on the lateral margins of elytra. Dark brown abdominal segments and two hair-like structure found on the sixth sternite. Strigil presents on the foreleg.

Locations: KUD, VEI, UPM, KVA, MLP, CRL, MPA, and MKL.

Habitats: Lake, agricultural fields, and waterfalls.

Remarks: This was widely found species. This was found mostly in stagnant waters of lakes and waterfalls. This was seen in nonshaded areas and edges of aquatic habitats. This was widely distributed across India and previously described from Kerala (Basu *et al.*, 2018c).

4. *Micronecta ludibunda* Breddin, 1905

(Plate 13: Fig. 23d-23f)

Material examined: 10 ♂; 2 ♀; 4 Nymph; Coll: S. Ranjini.

Diagnostic characters: The body medium sized and length up to 2 mm. Dark brown in colour. Head length 0.13 mm and interocular width 0.36 mm. Head blunt at tip and anteriorly light brown. Pronotum with round patches. Length of pronotum 0.300 mm and width 0.830 mm. Length of scutellum 0.27 mm and width 0.43 mm. Comb like structure on the apex of the Pala. Hemelytra with five brown spots on lateral margins and the two sports are usually connected on the basal part. Discrete longitudinal lines on the hemelytra (Fig. 23c). Length of wings 2.04 mm with distinct dark brown continuous lines. Hairy structures on the genital segments. Strigil on the sixth abdominal segments.

Locations: KOA, PEM, OLY, KOY, PLK, KKE, and MKL.

Habitats: Lake, pond, agricultural fields, backwaters, irrigation canals, and man-made pools.

Remarks: This species was poorly known one but found in seven localities. This was mostly found in lakes, ponds, and backwaters. This was seen abundantly in the edges and shaded parts of water bodies. This was previously described only from Assam and West Bengal in India (Thirumalai, 2007; Basu *et al.*, 2018c). This species was reported for the first time in Kerala and new report from South India.

5. *Micronecta desertana desertana* Distant, 1920

(Plate 14: Fig. 24a-24c)

Material examined: 8 ♂; 1 ♀; Coll: S. Ranjini.

Diagnostic characters: Body light brown and length from 2.5 mm to 2.8 mm and width of 1.3 mm. Light yellow coloured head with an unclear elongate orange spot on the centre of

the frontal part of vertex (Fig. 24c). Head length 0.95 mm and width 0.4 mm. A pair of orange spots as cloud nears the eyes. Interocular width 0.40 mm and width 0.12 mm. Greyish-brown coloured pronotum with yellowish margins below. Length of pronotum 0.33 mm and width 0.91 mm. Base of wings greyish. Light brown corium with three ambiguous fragmented dark brown longitudinal lines up to the right membrane of wings. Scutellum 0.28 mm wider. Pale, yellow-coloured legs and slightly darkened on the apex of the tarsus. Fore femur with a long basal hair on its inner edge, a row of four spines found in the inner margin. Mid femora longer and mid tibiae short. Venter dull yellow.

Locations: KAA, MUA, KOU, and MLR.

Habitats: Forest streams, river, and pond.

Remarks: This species was very rarely found and observed in four localities of Kerala. This was observed mostly in forest streams. This was previously observed from Karnataka, Tamil Nadu, Assam, Punjab, and Maharashtra (Thirumalai, 2007). This was the new report from Kerala.

6. *Micronecta khasiensis* Hutchinson, 1940

(Plate 14: Fig. 25d-25f)

Material examined: 5 ♂; 1 ♀; 1 Nymph; Coll: S. Ranjini.

Diagnostic characters: Body dark yellowish brown. Body length from 2.5 mm to 2.7 mm and width of 1.4 mm. Head pale yellow coloured with pale orange stripe on frons. Head length 0.21 mm and width 0.50 mm. Two uncleared orange spots near the inner edge of the eyes. Length of eye 0.30 mm and width 0.10 mm. Interocular width 0.42 mm. Dark brownish coloured pronotum and a little wider than head. Anteriorly the lateral margins dark brownish in colour. Brown scutellum and basal area of clavus yellowish brown on elytra. Greyish brown coloured corium. Brownish yellow legs. Fore femur with a long basal hair on its inner edge (Fig. 25f).

Locations: TRK, UPM, OLY, and MLP.

Habitats: Pond, agricultural fields, and lakes.

Remarks: This species was very rarely found in this region. This was mostly observed in the edges of ponds and lakes. This was seen in the nonshaded areas of water bodies. This was previously recorded only from Assam, West Bengal, and Meghalaya (Thirumalai, 2007; Basu *et al.*, 2018c). This was the new record from Kerala and first report from South India.

Family Naucoridae

Body brown or black in colour, flattened and oval. Well specialized raptorial forelegs. The body size ranges from 2 mm to 15mm. Yellow or green coloured markings present on the body. The breathing tube absent. Three segmented antennae. Rostrum three segments. Distinct tarsal claws present.

1. *Helocoris indicus* Montandon, 1897

(Plate 15: Fig. 26a-26c)

Material examined: 6 ♂; 4 ♀; 4 Nymph; Coll: S. Ranjini.

Diagnostic characters: Blackish, oval, and wider body. Body length from 9 mm to 9.5 mm and width of 6 mm. Dull yellowish brown with dark spots and markings on the head and pronotum. Pronotum wider than long. Dark brownish scutellum with light brown spot on the end. Wing membrane black. Fore femora wider than long (Fig. 26c). Numerous spines present on the outer margin of the mid tibia.

Location: MLP.

Habitat: Lake.

Remarks: This species was found in the stagnant waters of lake. This was observed near the rocky areas, and in the nonshaded part of lake. It was seen in the edges of the rocks.

This species was previously known from Andhra Pradesh, Karnataka, Tamil Nadu, Maharashtra, Chhattisgarh, and from Kerala (Jehamalar & Chandra, 2016).

Family Notonectidae

The species under this family swimming back, called as 'back swimmers. Small and medium-sized, elongate bugs. Ocelli absent. Three to four segmented rostrum and antennae four segmented. Hind legs flat and lacking claws. Forelegs not raptorial.

1. *Anisops nasutus* Fieber, 1851

(Plate 15: Fig. 27d-27f)

Material examined: 26 ♂; 5 ♀; 1 Nymph; Coll: S. Ranjini.

Diagnostic characters: Light brownish body, length varies from 6 mm to 7.8 mm and width from 1.3 mm to 1.8 mm. The head rounded and synthlipsis very narrow. Scutellum light orange-coloured. Frons protruded as cephalic projection dorsally with a broadly indented apex (Fig. 27f). Rostral prong slightly shorter than the third rostral segment. Anteriorly tylus with a small depression appearing flat. Fore femur apically narrowed. Stridulatory comb on foretibia with 14 teeth.

Locations: CHU, ATY, MAM, KAU, PAI, PEM, UPM, CMA, YKA, NUI, ANM, AYD, MNR, CHA, KOT, DHM, and TSY.

Habitats: Pond, river, agricultural fields, irrigation canals, Kole wetlands, backwaters, and man-made pools.

Remarks: This species was widely distributed and commonly found across Kerala. This was mostly observed in the nonshaded areas of water bodies. This was found abundant in ponds, rivers, and agricultural fields. This was previously known from Kerala (Thirumalai, 2007).

2. *Anisops breddini* Kirkaldy, 1901

(Plate 16: Fig. 28a-28c)

Material examined: 19 ♂; 17 ♀; 5 Nymph; Coll: S. Ranjini.

Diagnostic characters: Body pale greyish in colour and the length from 6 mm to 6.6 mm and width from 1.2 mm to 1.7 mm. Head long, as wide as pronotum and conical in appearance (Fig. 28c). Holoptic eyes posteriorly. Lateral margin of eyes slightly convex. Vertex slightly projecting beyond the anterior margin of eyes. Width of pronotum sub-equal to the width of head. Dark brown abdominal sternum. Hemelytra with the reduced membranes. Fore femur wider than long and strongly swollen. Fore tibia slightly longer than tarsus. Stridulatory comb on foretibia with few irregular teeth. Mid tibia with a long claw.

Locations: VEI, CHM, KOU, KIY, THR, KAU, PAI, ALE, ERA, PEM, UPM, CMA, NUI, ANM, MNR, ESW, and KKL.

Habitats: Lake, agricultural fields, pond, irrigation canals, river, backwaters, forest streams, and man-made pools.

Remarks: Very common and widespread species across Northern and Southern India. This was seen in the edges and rocky areas of water bodies. This was found numerous in the ponds, rivers, and lakes. This was previously known from Kerala (Thriumalai, 2007).

3. *Anisops bouvieri* Kirkaldy, 1904

(Plate 16: Fig. 29d-29f)

Material examined: 5 ♂; 2 ♀; 2 Nymph; Coll: S. Ranjini.

Diagnostic characters: Yellowish brown body and length of 6 mm to 6.3 mm. Head with long cephalic horn with acute apex (Fig. 29f) and larger, which may be one fifth of its ventral length and reaching beyond the anterior margin of eyes. Synthlipsis narrow.

Labrum with three narrow hair tufts, two at each basal angle and one at the apex. Rostral prong slightly shorter than the third rostral segment. Forefemur narrow at tip. Stridulatory comb on foretibia with 12 teeth.

Locations: KOU, MAM, and THR.

Habitats: Pond, agricultural fields, and irrigation canals.

Remarks: This species was widely distributed and rarely found in this region. This was found in the nonshaded areas of aquatic habitat. This was observed mostly in the irrigation canals, and agricultural fields. This was previously reported from Kerala (Thirumalai, 2007).

4. *Anisops barbatus* Brooks, 1951

(Plate 17: Fig. 30a-30b)

Material examined: 4 ♂; 1 Nymph; Coll: S. Ranjini.

Diagnostic characters: Body elongated and yellowish brown in colour. Body length ranges from 8 mm to 9 mm and width from 2.7 mm to 3 mm. Anterior margin of head truncate. Head broader anteriorly and the head width more than vertex width. Rostral prong slightly shorter than the third rostral segment. Scutellum small and milky white in colour (Fig. 30a). Hemelytra yellowish white. Forefemur narrow at apex. Stridulatory comb present on the fore tibiae with 20-25 teeth.

Location: THR.

Habitats: Pond, irrigation canals, and agricultural fields.

Remarks: This species was widely distributed across Northern India, Karnataka, and Tamil Nadu (Thirumalai, 2007), but poorly known one in this region. This was found only in one localities of Palakkad District. This was observed mostly in the nonshaded areas of water bodies. This was the new report from Kerala.

5. *Anisops sardeus sardeus* Herrich-Shaffer, 1850

(Plate 17: Fig. 31d-31f)

Material examined: 9 ♂; 7 ♀; Coll: S. Ranjini.

Diagnostic characters: Body pale yellow or brownish yellow in colour. Body length ranges from 7.5 mm to 8.4 mm and width of 1.8 mm. Eyes brownish coloured. Head wider than pronotum. The interocular space produced into a distinct cephalic horn like beak (Fig. 31f) with frons excavates of its entire length and bordered by two carinae laterally. Hemelytra transparent and brown in colour. Abdominal venter black with keel. Stridulatory comb present on the fore tibia with 18 teeth. Mid tarsal claws sturdily curved. A pair of setae present on both sides of last abdominal segment.

Locations: KOU, MAM, THR, ALE, ERA, KPM, UPM, and OLY.

Habitats: Pond, agricultural fields, and irrigation canals.

Remarks: This species was widespread across Northern and Southern India (Thirumalai, 2007). This was found numerous in the edges of the agricultural fields. This was observed in both shaded and nonshaded areas of water ecosystems. This was the new report from Kerala.

6. *Anisops niveus* Fabricius, 1775

(Plate 18: Fig. 32a-32c)

Material examined: 16 ♂; 12 ♀; 1 Nymph; Coll: S. Ranjini.

Diagnostic characters: Body off-white coloured and length ranges from 4.8 mm to 5.1 mm and width from 1.2 to 1.4 mm. Head anteriorly truncate and vertex slightly depressed (Fig. 32c). Rostral prong slightly shorter than the third rostral segment and originating near the proximal margin. Labrum with long hairs. Wings extended to last abdominal segments. Forefemur apically narrowed. Stridulatory comb on fore tibia with 13 teeth.

Locations: VEI, KEA, KOU, MAM, THR, KAU, PAI, UPM, YKA, KKL, DHM, TSY, PLK, and TKD.

Habitats: Lake, pond, agricultural fields, irrigation canals, river, forest streams, and man-made pools.

Remarks: This species was commonly seen and found numerous in agricultural fields and irrigation canals. This was observed in nonshaded areas of aquatic habitats. This was previously reported from Kerala (Thriumalai, 2007).

7. *Anisops paranigrolineatus* Brooks, 1951

(Plate 18: Fig. 33d-33f)

Material examined: 6 ♂; 1 ♀; Coll: S. Ranjini.

Diagnostic characters: Body long, elongated, and brown coloured. Body length up to 6 mm and width of 1.3 mm. Head yellowish brown in colour. Eyes dark brown and wider than interocular width. Pronotum wider than long. Hemelytra transparent and black in appearance (Fig. 33d). Fore femur broad with pointed apex.

Locations: AAU, and NUI.

Habitats: Rock pools and pond.

Remarks: This species was poorly known one and rarely found in this region. This was observed in the stagnant waters of aquatic ecosystems. This was previously recorded from Kerala (Thriumalai, 2007).

8. *Anisops tahitiensis* Lundblad, 1934

(Plate 19: Fig. 34a-34c)

Material examined: 4 ♂; 2 ♀; Coll: S. Ranjini.

Diagnostic characters: Body black in colour. Body length ranges from 5.1 mm to 6 mm and width of 1.3 mm to 1.5 mm. Head anteriorly slightly truncate (Fig. 34c). Labrum without hairs. Rostrum long and stout. Rostral prong slightly longer than the third rostral segment, originating near the distal margin. Tylus swollen anteriorly. Synthlipsis narrow and about one third of the anterior width of vertex. Scutellum with three dark brown longitudinal rectangular spots and an additional vertical line at its base (Fig. 34b). Pale, yellowish-coloured hemelytra. Stridulatory comb present on the fore tibia with 34 teeth.

Locations: TSY and PLK.

Habitat: Man-made pools.

Remarks: This species was very rare and observed only in man-made pools. This was found in nonshaded areas. This bug species was previously reported from Andaman Nicobar Island and West Bengal (Jehamalar & Chandra, 2013c; Jehamalar *et al*., 2014a). This was the new report from Kerala and recorded for the first time from South India.

9. *Anisops occipitalis* Breddin, 1905

(Plate 19: Fig. 35d-35f)

Material examined: 6 ♂; 5 ♀; 1 Nymph; Coll: S. Ranjini.

Diagnostic characters: Body long, elongate, and yellowish grey in colour. Body length varies from 7.6 to 7.7 mm and width from 1.6 mm to 2.2 mm. Head truncate anteriorly (Fig. 35f). Synthlipsis wide. Rostrum long and slightly protruded on posterior side. Rostral prong longer than the third rostral segment and reaching near the distal margin. Short hairs present on labrum. Tylus flat and swollen slightly. Fore femur with a wide shallow indentation in apical third portion dorsally and broadly rounded apex. Fore tibiae with four short stout spines near the stridulatory comb. Stridulatory comb with 20 - 25 teeth. Fore tibia with longitudinally arranged minute tentacles.

Locations: ATY, and TRK.

Habitats: River and pond.

Remarks: This species was rarely found in this region. This was observed in the nonshaded part and edges of pond and river. This was previously recorded from Andaman Nicobar Islands and Meghalaya (Jehamalar & Chandra, 2013c; Jehamalar & Chandra, 2020). This was the new record from Kerala and first report from South India.

10. *Nychia sappho* Kirkaldy, 1901

(Plate 20: Fig. 36a-36c)

Material examined: 18 ♂; 16 ♀; 9 Nymph; Coll: S. Ranjini.

Diagnostic characters: Body long, slender, elongate, oval and yellowish in colour. Body length of 4 mm and width of 1.2 mm. Holoptic eyes. Eyes dark reddish coloured, forming an ocular commissure on basally. Eyes very large, kidney-shaped to semi-circular, dorsally covering the inner margins and touching each other in the posterior end (Fig. 36c). Head with raised vertex (Fig. 36a). Head not as broad as pronotum. Pronotum broader than long and distinctly foveate in the antero-lateral margins. Three segmented antennae and hidden inside a groove on the ventral side. Interocular region narrow. Rostrum long and dark brown in colour. Scutellum small and dark. Abdominal sternites with long dark hairs. Fore femur with seven spines. Fore tarsi two segmented. Mid femur with a pair of stout bristles.

Locations: CHU, PAA, CHY, AAU, KAU, PAI, ALR, PEM, UPM, NUI, KLY, TMM, MNR, ESW, KOY, KKL, KCA, SBY, MVL, POK, and PLK.

Habitat: Pond, river, rock pools, agricultural fields, irrigation canals, backwaters, forest streams, and man-made pools.

Remarks: This species was poorly known from India, only reported from Tamil Nadu, Pondicherry, and West Bengal (Basu *et al.*, 2018c). This was very common and widely distributed in this region. This was found in both shaded and nonshaded areas of aquatic

habitats. This was seen mostly in the ponds, rivers, and agricultural fields. This was new report from Kerala.

11. *Enithares ciliata* Fabricius, 1798

(Plate 20: Fig. 37d-37f)

Material examined: 7 ♂; 2 ♀; Coll: S. Ranjini.

Diagnostic characters: Body long, and elongate or oval. Body length up to 8.5 mm to 10 mm. Dorsally dark brown or black in colour. Scutellum large and black coloured. A pair of yellowish white longitudinal markings on the lateral margins of the scutellum. Eyes broader. Pronotum large and anteriorly covered with yellowish-white band behind the eyes. The basal part of hemelytra luminous. Meso-trochanter rounded with a covering of black spicules along the ventral margin. The first mid tarsi triangular and the mid tibiae bluntly produced at the apex. Mid tarsal segment with claws (Fig. 37f).

Locations: ADI, AAU, VAI, PAU, KAU, NEY, and ALE.

Habitats: Streams, rock pools, man-made pools, and pond.

Remarks: This species was commonly found and widely distributed. This was observed in nonshaded areas of aquatic ecosystems. This was mostly seen in the edges of stagnant water bodies. This was previously reported from Kerala (Thirumalai & Radhakrishnan, 1999).

Family Pleidae

Very minute, dense, and condensed body. The body size ranges from 1.5 mm to 3 mm. The head and thorax segments not fused. The head quite large and directed downward. Short rostrum and three-segmented. The reddish, orange-coloured spots and vertical lines present or absent on the vertex. Sloppy down abdomen. Exposed dark yellow scutellum. Distinct spots present on the whole body.

1. *Paraplea frontalis* Fieber, 1844

(Plate 21: Fig. 38a-38c)

Material examined: 42 ♂; 27 ♀; 12 Nymph; Coll: S. Ranjini.

Diagnostic characters: Body small, pale yellowish brown with well-defined pale dots dorsally and the body length from 2 mm to 2.5 mm. Large reddish-brown eyes and ocelli absent. Scutellum triangular and yellow in colour. Two pairs of small an indistinct reddish oval spot and one median longitudinal stripe present above the streak on the vertex (Fig. 38c). Interocular width greater than eye width. Pronotum wider and covered with uneven punctures. Hemelytra with very fine hairs. Abdominal sternites with a prominent keel and spine.

Locations: CHU, KUD, VEI, KUM, VED, KUR, POA, MAM, THR, KAU, ALE, ALR, KUL, PEM, THK, KPM, TRK, UPM, CMA, YKA, AGT, MLR, NUI, VAR, WAL, OLY, KLY, KUU, MNR, PNI, ESW, KOT, KLA, TSY, PLK, KKE, and MKL.

Habitats: Pond, lake, backwaters, agricultural fields, irrigation canals, river, and man-made pools.

Remarks: This species was very common and found in the aquatic habitat with mass aquatic vegetations of water lettuce. This was found in both shaded and nonshaded part of aquatic habitats. This was abundantly seen in ponds, lakes, and rives. This was widely distributed across Southern and Northern parts of India (Basu *et al.*, 2018c). This water bug species was the new report from Kerala.

2. *Paraplea liturata* Fieber, 1844

(Plate 21: Fig. 39d-39f)

Material examined: 5 ♂; 1 ♀; Coll: S. Ranjini.

Diagnostic characters: Body small sized, ovoid, strongly convex shaped, pale in colour and the body length ranges from 1.3 mm to 2 mm. Eyes large and ocelli absent. Head with only a median reddish brown longitudinal stripe. Antennae three segmented and not visible from above. Rostrum short, stout and four segmented. Pronotum wider, quadrate with typical small pale dots and well defined five round reddish-brown humeral spots present, one at each humeral angle, a middle one near the posterior margin, and a pair more anteriorly near the midline (Fig. 39f). The hemelytra with brown transverse bands in the middle.

Locations: VEI, AGT, ESW, and MKL.

Habitats: Lake, pond, and agricultural fields.

Remarks: This species was poorly known one and rare. This was observed only in four localities of Kerala. This was found in both shaded and nonshaded areas of water bodies. This was previously recorded from Assam and West Bengal (Saha & Gupta, 2019; Saha *et al.*, 2020). This was reported for the first time in Kerala and new report from South India.

Family Helotrephidae

Oval or globular body. Head and pronotum fused and directed downward. One or two segmented antennae and wider scutellum.

1. *Tiphotrephes indicus* Distant, 1910

(Plate 22: Fig. 40a-40c)

Material examined: 2 ♂; Coll: S. Ranjini.

Diagnostic characters: Brownish yellow, very small, oval body and the length up to 1.5 mm. Body extremely emarginated downward. A distinct punctuate on dorsal side of the head. Pronotum with a dark brown clouded puncture above the scutellum (Fig. 40a).

Clavus absent in elytra. Corium pale yellow. Scutellum brownish in colour with a pale horizontal line on anterior part. Venter dark with yellowish border on lateral side.

Location: TRK.

Habitat: Pond.

Remarks: This species was found only in the large pond with less aquatic vegetation. It was nonshaded pond and used in fish rearing as well as bathing. This species was previously recorded only from Maharashtra, West Bengal, and Uttar Pradesh (Basu *et al.*, 2018c). This was the new report from Kerala and the first report from South India.

INFRAORDER GERROMORPHA

Family Gerridae

The body size ranges from 2 mm to 40 mm. Elongate or oval body with sub-apical claws and the colour varies from black to brown. The body is covered with velvety hairs. Silvery markings on the dorsal sides in some species. Middle legs longer than hind legs. Hind femora extending up to the abdomen.

1. *Limnogonus (Limnogonus) fossarum fossarum* Fabricius, 1775

(Plate 22: Fig. 41d-41f)

Material examined: 18 ♂; 21 ♀; 8 Nymph; Coll: S. Ranjini.

Diagnostic characters: Body long, elongated black with yellow markings dorsally and grey coloured ventrally and the length up to 8.5 mm. Pronotum wider with yellow markings. Yellow stripes on the sub-marginal side clearly visible beyond the metanotum. Metanotum with yellow stripes basally. The yellow lateral line often separated from the anterior pronotum (Fig. 41f). The two small yellow spots on the anterior pro-notal lobe separated with black lines vertically.

Locations: POA, KOU, PAI, KUL, PEM, KPM, CMA, YKA, MPK, NUI, PMU, KLY, MNR, ESW, KOT, KVR, TSY, BKL, PLK, CHI, and MKL.

Habitats: Lake, pond, river, agricultural fields, man-made pools, backwaters, man-made pools, and mangroves.

Remarks: This was commonly found and predatory water bug species. This was found mostly in the shaded areas of water bodies. This was very abundantly observed in ponds, lakes, and rivers. This species was also collected from light. They attracted to light source near the aquatic habitat. This was previously known from Kerala (Thirumalai & Radhakrishnan, 1999).

2. *Limnogonus (Limnogonus) nitidus* Mayr, 1865

(Plate 23: Fig. 42a-42c)

Material examined: 26 ♂; 14 ♀; 3 Nymph; Coll: S. Ranjini.

Diagnostic characters: Black coloured body dorsally and yellowish to silvery white ventrally. Body small, elongate and length from 6 mm to 8 mm. Head small and with paired yellowish longitudinal lines. Interocular width longer than the width of head. Rostrum long, stout and reaching up to the pronotum. Pronotum wider and shining black in colour. Two small yellow spots on the anterior pronotal lobe (Fig. 42c). Scutellum large with yellow covering on basal part. Wings dark greyish in colour. Four segmented antennae. Fourth antennal segment longer than the rest of the three segments. First antennal segments longer than the second and third. Fore femur without any modification. Two segmented fore tarsi. The seventh abdominal segments provided with prominent connexival spines. Genital segments elongated.

Locations: OOA, PAM, POA, KOU, THR, KAU, PEM, THK, KPM, MLP, PMU, KLY, KUU, PUM, PLK, and MKL.

Habitats: Pond, irrigation canals, lakes, agricultural fields, river, and man-made pools.

Remarks: This species was widespread across India. This was very common in this region and observed in both shaded and nonshaded part of aquatic habitat. This was seen numerous in ponds, agricultural fields, lakes, and rivers. This was also collected from light source. They attracted to light from the nearby pond. This was previously identified species from Kerala (Thirumalai & Radhakrishnan, 1999).

3. *Limnometra fluviorum* Fabricius, 1798

(Plate 23: Fig. 43d-43f)

Material examined: 8 ♂; 4 ♀; 1 Nymph; Coll: S. Ranjini.

Diagnostic characters: Body long, elongate, and dark brownish to black coloured with black markings. Ventrally pale yellow in colour. Body length up to 10.6 mm. Eyes black in colour. Hemelytra dark brown with prominent black markings. Antennae long and four segmented. First antennal segments longer than the rest of the three segments. The fourth antennal segments longer than the second and third. The second antennal segments shorter or sub-equal in length. Fore femur long and slender. Meso-coxa of mid leg with a spine like projection on the lateral margin. Connexival spines long and curved (Fig. 43f).

Locations: MUA, AAU, ALE, and APM.

Habitats: River, rock pools, pond, and forest streams.

Remarks: This was widespread species. This was observed only in four localities of Kerala. This was mostly seen in forest streams, ponds, and rivers. This was found in the shaded areas of water bodies. This was previously reported from Kerala (Thirumalai & Radhakrishnan, 1999)

4. *Limnometra anadyomene* Kirkaldy, 1901

(Plate 24: Fig. 44a-44c)

Material examined: 14 ♂; 5 ♀; 3 Nymph; Coll: S. Ranjini.

Diagnostic characters: Black to dark brownish body. The body length up to 14. 6 mm. The length of the femur in the mid leg longer than the body. Mesocoxal part without spines (Fig. 44c). Tarsi two segmented. The second tarsal segments of foreleg longer than first. Long and stout connexival spines extending to the first genital segment.

Locations: KAA, CHM, MUM, ADI, KVR, KKL, PYR, KPU, and MKL.

Habitats: Forest streams, agricultural fields, pond, man-made pools, mangroves, and irrigation canals.

Remarks: This species was widespread species in this region. This was found in shaded areas of water bodies. This was found numerous in the edges of pond ecosystems. This was previously reported from Kerala (Thirumalai & Radhakrishnan, 1999).

5. *Neogerris parvulus* Stal, 1859

(Plate 24: Fig. 45d-45f)

Material examined: 7 ♂; 8 ♀; 2 Nymph; Coll: S. Ranjini.

Diagnostic characters: Body small, elongated, and black in colour. The body length from 6 mm to 6.5 mm. Head short and protruding forward. Head with U-shaped yellowish-brown markings. Rostrum long and stout. Eyes black in colour. Pronotum with two large round or quadrangular yellowish-brown spots anteriorly (Fig. 45f). Antennae long and four segmented. First antennal segments longer than the rest of the three segments. The fourth antennal segments almost half the length of first segment. Hemelytra pale brown in colour. Mid and hind femora fringed with short spines. Prolonged abdominal segments. The hind margin of pygophore straight.

Locations: KAI, PEM, CMA, CHA, ESW, and MKL.

Habitats: Pond, agricultural fields, river, and lakes.

Remarks: This species was widely distributed and commonly observed. This was found mostly in the lakes, and ponds. This was seen in shaded areas of aquatic ecosystems. This was previously recorded from Kerala (Thirumalai & Radhakrishnan, 1999).

6. *Aquarius adelaides* Dohrn, 1860

(Plate 25: Fig. 46a-46c)

Material examined: 9 ♂; 11 ♀; Coll: S. Ranjini.

Diagnostic characters: Dark brownish to black body dorsally and dark grey ventrally. Body elongated and length varies from 11 mm to 12.5 mm and width of 3 mm. Head, rostrum, pronotum and legs black in colour. Crescent-shaped pale markings present at the base of the head. Rostrum long, stout and extending beyond the posterior margin of prosternum. Pronotum long, black, and yellow markings basally. Pronotal lobe brownish yellow in colour. Antennae long, slender and four segmented. The first antennal segment longer than the rest of the three segments. The third antennal segments shorter than the second and fourth segments. Fore femur almost straight and terminating with two distinct spines. Mid femur with numerous spines. Hind femur longer than the body. Slender abdomen and connexival spines distinctly visible. Connexival spines stout and long, reaching up to the abdominal end (Fig. 46c). The male parameres conical and setose.

Locations: PAA, AAU, DHI, KAR, PEM, THK, NUI, PMU, and TMM.

Habitats: River, rock pools, waterfalls, forest streams, pond, and agricultural fields.

Remarks: This species was predatory in nature and commonly found. This was mostly seen in shaded areas of water bodies. This was found abundant in the edges of ponds, and rivers, and stagnant waters forest streams. This was previously identified species from Kerala (Thirumalai & Radhakrishnan, 1999).

7. *Rhagadotarsus kraepelini* Breddin, 1905

(Plate 25: Fig. 47d-47f)

Material examined: 22 ♂; 14 ♀; 5 Nymph; Coll: S. Ranjini.

Diagnostic characters: Black coloured body dorsally covered with bluish grey pubescence and grey coloured ventrally and the length up to 4.2 mm. Head short and broad. Eyes dark brown in colour. Four segmented antennae and the antennal segments fringed with short hairs. Pronotum wider than long and much shorter than head length. Rostrum long and extending up to the fore coxa. Yellowish brown coloured on the first two segments of the legs. Fore femur fringed with two rows of long setae. Mid femora longer than the hind femora. Claws long and sharp. Abdomen with 7 segments ventrally. Abdominal tergites terminally prolonged, narrow and the first tergite fused with metanotum. Connexivum broad. Genital segment long and elongated.

Locations: ARA, PAA, PAM, KIY, ERA, PEM, TRK, NUI, PMU, TMM, KOY, and KDY.

Habitats: River, irrigation canals, pond, agricultural fields, backwaters, and man-made pools.

Remarks: This species was widespread and commonly found. This was observed mostly in rivers, ponds, and backwaters. This was found in both shaded and nonshaded areas of water bodies. This was previously known from Kerala (Thirumalai & Radhakrishnan, 1999).

8. *Ptilomera (Ptilomera) agroides* Schmidt, 1926

(Plate 26: Fig. 48a-48d)

Material examined: 9 ♂; 7 ♀; Coll: S. Ranjini & C. Selvarajan.

Diagnostic characters: Body long, elongate, and dark brown to black in colour. Body length up to 17 mm. Thorax with black longitudinal band on lateral sides. Fore femur long with a small black protuberance in the middle part and silvery pilosity ventrally. Hind femur longer than mid femur and fringed with a row of hairs ventrally. Rostrum long and stout. Pronotum wider than long. Suranal plate broadly rounded in the median lobe (Fig. 48c). Pygophore projection extending the lateral wings of suranal plate by half of their length (Fig. 48d). Longer parameres with pointed tip projecting forward.

Locations: NEY, KOE, ANL, KKL, CRL, and KOR.

Habitats: Lake, torrential streams, forest streams, man-made pools, waterfalls, and river.

Remarks: This species was predatory in nature and observed more in torrential streams and waterfalls. This was the previously observed and identified species from Maharashtra, Karnataka, Odisha, Madhya Pradesh and from Kerala (Thirumalai & Radhakrishnan, 1999; Basu *et al.*, 2018c).

9. *Ptilomera (Ptilomera) assamensis* Hungerford & Matsuda, 1965

(Plate 26: Fig. 49e-49h)

Material examined: 5 ♂; 1 ♀; Coll: S. Ranjini.

Diagnostic characters: Yellowish brown coloured body. Elongate species and length up to 14.5 mm. Antennae long and four segmented. The third and fourth antennal segments fused. The first antennal segment longer than the second. Pronotum wider than long. Rostrum long and stout. Suranal plate broad with median lobe (Fig. 49g). Short pygophore and truncated on the apex. The dorsolateral projections short and broad on basal side (Fig. 49h).

Locations: NEY, and KKL.

Habitats: Forest streams.

Remarks: Mostly found in shaded and rocky areas of forest streams. This was very rare in this region. This species was previously reported from Assam, West Bengal, and Arunachal Pradesh (Basu *et al.*, 2018c). This was the new report from Kerala and first report from South India.

10. *Ptilomera (Ptilomera) laticaudata* Hardwicke, 1823

(Plate 27: Fig. 50a-50d)

Material examined: 1 ♂; 1 ♀; Coll: S. Ranjini.

Diagnostic characters: Metallic brown coloured body dorsally and the length of 14 mm. Metallic white coloured on ventrally and laterally. Head longer than wide. Antennae long and four segmented. First antennal segments longer than the other three segments. Pronotum wider than long (Fig. 50b). Metacoxa with prominent spine at rear margin. Pygophore with median lobe short, broad, and bluntly pointed tip. Paramere with hairy end.

Location: KSD.

Habitat: River.

Remarks: This species was very rare in this region. This was found only in the Kabani River, Wayanad District. This was found numerous in the tree shaded areas but, only two specimens were collected. This was previously recorded from Arunachal Pradesh, Himachal Pradesh, Uttarakhand, Sikkim, and West Bengal (Jehamalar *et al.*, 2018c). This was the new report from Kerala and first record from South India.

11. *Pleciobates nostras* Thirumalai, 1986

(Plate 27: Fig. 51e-51g)

Material examined: 5 ♂; 3 ♀; Coll: S. Ranjini.

Diagnostic characters: Dark black body with yellow markings. Fusiform body with 7 mm in length. Grey with silvery pilosity on ventral side. Antennae brownish black coloured, four segmented and shorter than the body. First antennal segments longer than the rest of the three segments. Fourth antennal segment shorter. The third antennal segment longer than the second. Head brown in colour, protruding beyond the eyes and with a pair of longitudinal lines anteriorly near the inner margin of eyes. Head wider than long. Eyes brown in colour. Rostrum stout, brown coloured and not extending beyond the prosternum. Pronotum wider than long. Anterior and posterior margins of pronotum slightly curved and lateral margins concave in appearance with grey coloured pubescence (Fig. 51g). Legs brownish black in colour. Fore femur with a row of small spines on the inner margins. Fore tibiae shorter than the fore femur. Fore tarsi two segmented. Mid femur longer than the body. Dorsally silvery pubescence on abdomen. Connexivum well developed with distinct spines.

Location: ATY.

Habitat: River.

Remarks: This was previously known species. Although, this was rarely found and seen only in the edges of river ecosystem. This was previously reported species. This was distributed only in Karnataka and Kerala (Thirumalai, 1986).

12. *Pleciobates indicus* Thirumalai, 1986

(Plate 28: Fig. 52a-52c)

Material examined: 9 ♂; 5 ♀; Coll: S. Ranjini.

Diagnostic characters: Black body with dark yellowish-brown markings. Ventrally grey with silvery pubescence (Fig. 52b). Head with a large black spot anteriorly. Head protruding forward beyond the eyes. Head wider than long. Dark brown eyes. Antennae longer than body and four segmented (Fig. 52a). First antennal segment longer than the rest of the three segments. The second and fourth antennal segments sub-equal in length.

Fourth segment shorter. The second antennal segments shorter than third. Rostrum long, stout, and hairy. Rostrum dark brown in colour and extending beyond the basal part of the prosternum. Pronotum wider than long. Pronotum, mesonotum and metanotum covered with silvery pilosity. Forelegs with two black stripes. Femur longer and hairy. Tarsi of all legs two segmented. Dorsal part of the abdomen covered with small silvery pubescence. Connexivum well developed without spines.

Location: MLP.

Habitat: Lake.

Remarks: This was found in the stagnant waters and shaded areas of lake. This was previously reported species and observed only from Kerala (Thirumalai, 1986). Although, this was very rarely found species in Kerala.

13. *Amemboa kumari* Distant, 1910

(Plate 28: Fig. 53d-53f)

Material examined: 17 ♂; 12 ♀; 3 Nymph; Coll: S. Ranjini.

Diagnostic characters: Black elongate body and length up to 3.3 mm with prominent yellowish orange markings dorsally. Ventrally a vertical median black stripe as well as the two sub-lateral stripes on pale yellowish body. Head small and directed forward. Head with a distinct median yellowish-orange markings and two sub-lateral stripes. Antennae long and four segmented. The fourth antennal segments longer than the rest of the three segments. The third antennal segment shorter or equal to the first. Eyes large, globular, and reddish brown in colour. Pronotum wider than long. The pronotum with two median and two sub-lateral longitudinal streaks anteriorly. Abdomen dark with yellow markings. Fore femur longer than broad with hair tufts (Fig. 53f). Mid femur long.

Locations: MUA, CHY, MKD, ANL, APM, and KVR.

Habitats: River, irrigation canals, agricultural fields, torrential streams, forest streams, and pond.

Remarks: This species was widely distributed in this region. This was observed numerous in the rocky areas of forest streams, and rivers. This was found in both shaded and nonshaded areas. This bug species was previously recorded from Karnataka, Tamil Nadu, Odisha, West Bengal and from Kerala (Thirumalai, 2002a; Basu *et al.*, 2018c).

14. *Metrocoris darjeelingensis* Basu, Polhemus & Subramanian, 2016

(Plate 29: Fig. 54a-54c)

Material examined: 2 ♂; Coll: S. Ranjini.

Diagnostic characters: Yellowish-orange coloured body with distinct black markings dorsally and dark coloured ventrally. Small, oval and body length up to 5.2 mm. Interocular dark rectangular marking on the head. Head small and dark in colour. Four segmented antennae. Third antennal segment distinctly longer than second (Fig. 54c). Rostrum long, slender and extending up to the fore coxa. Pronotum broad and slightly raised. Fore femur long with hairy structures. Yellow markings on the basal part of the fore femora and a slight invagination on the mid region.

Location: KJK.

Habitat: Lake.

Remarks: Rarely found species in this region. This was previously reported from Sikkim, West Bengal, and Arunachal Pradesh (Basu *et al.*, 2018c). This was found in the lake of near the hill areas of Kanjikode, Palakkad District. This water bug species was recorded for the first time in Kerala.

15. *Metrocoris communoides* Chen & Neser, 1993

(Plate 29: Fig. 55d-55f)

Material examined: 7 ♂; 4 ♀; Coll: S. Ranjini.

Diagnostic characters: Body small, oval, and black with yellow markings. Body length up to 4.9 mm. The second antennal segments slightly longer than the third (Fig. 55f). Rostrum small and stout. Pronotum small and prominent. Interocular dark spot rectangular in shape. Fore femur broad with a small tooth on ventral side.

Location: MLP.

Habitat: Lake.

Remarks: This species was previously recorded from Tamil Nadu, Odisha, and Himachal Pradesh (Thirumalai, 2002a; Basu *et al.*, 2018c). This was found numerous in the Malampuzha lake, Palakkad District. This was observed in the rocky shores and tree shaded part of lake. This was the new report from Kerala.

16. *Ventidius (Ventidius) aquarius* Distant, 1910

(Plate 30: Fig. 56a-56c)

Material examined: 8 ♂; 2 ♀; 1 Nymph; Coll: S. Ranjini.

Diagnostic characters: Body black in colour, oval and dorsoventrally flattened. Ventrally light brown in colour. The body length up to 4 mm and width of 3 mm. Head longer than broad. Four segmented antennae. First antennal segment longer. The second and third antennal segments equal in length. Pronotum long with T-shaped black markings in macropterous (Fig. 56c).

Locations: MUM, KKL, and CRL.

Habitats: Forest streams, man-made pools, and waterfalls.

Remarks: This species was widespread and commonly found in the streams and water falls of hilly areas. This was observed in both shaded and nonshaded areas of water bodies. This was previously reported from Kerala (Thirumalai, 2002a).

17. *Naboandelus signatus* Distant, 1910

(Plate 30: Fig. 57d-57f)

Material examined: 18 ♂; 6 ♀; 3 Nymph; Coll: S. Ranjini.

Diagnostic characters: Body dark brown to black in colour and dorsoventrally flattened. Body length varies from 1.5 mm to 2 mm. Head light brownish coloured and dorsally with a large dark brown marking between the eyes. Lateral margins of intraocular region covered with yellow markings. Anterior part of pronotum with a median large yellow spot dorsally (Fig. 57f). Four segmented antennae. First antennal segment longer than the head.

Locations: ARA, PAA, PEI, PAM, ALE, PEM, THK, UPM, NUI, PMU, and CHA.

Habitats: River, irrigation canals, lakes, pond, and agricultural fields.

Remarks: This species was widely distributed across Northern and Southern India such as Karnataka, Tamil Nadu, Pondicherry, West Bengal, and Uttar Pradesh (Thirumalai, 2002a). This water bug species was very small sized and widespread in this region, and this was new report from Kerala.

18. *Lathriobates raja* Distant, 1910

(Plate 31: Fig. 58a-58c)

Material examined: 10 ♂; 4 ♀; Coll: S. Ranjini.

Diagnostic characters: Yellowish to orange body dorsally and yellowish grey in colour ventrally. The body of this species small, oval, and dorsoventrally flattened. Four

segmented antennae. The third antennal segments longer than the rest of the three segments. The fourth antennal segments longer than the first two segments. The second antennal segments shorter than the first segments. Head yellowish orange coloured with two setae near the anterior margin of the eyes. Pronotum broader than long. Pronotum with three black stripes. Median stripes of pronotum straight and the lateral stripes slightly curved (Fig. 58c). The third and fourth abdominal tergites with a narrow median stripe. Fore tibia curved in appearance. Fore tarsus with two claws.

Locations: KAA, ATY, PAM, and KOY.

Habitats: Forest streams, river, irrigation canals, and backwaters.

Remarks: This water bug species was previously known and poorly distributed in this region. This was seen near the edges of the stagnant waters. Mostly observed in forest streams, and rivers. This species was only recorded from Kerala (Thirumalai & Radhakrishnan, 1999).

19. *Cylindrostethus productus* Spinola, 1840

(Plate 31: Fig. 59d-59g)

Material examined: 4 ♂; 3 ♀; Coll: S. Ranjini.

Diagnostic characters: Very long and elongate species. Body length up to 24.4 mm. Body dark in colour. Head black with yellow lines vertically. Four segmented antennae. First antennal segment particularly longer than the other three segments (Fig. 59e). Large eyes and reddish brown in colour. Pronotum wider than long. Meso-sternum and meta-sternum noted with a prominent keel vertically. Abdomen long and slender. Fore femora slender and marked with a distinct tooth. A row of short hairs on the inner margin of the fore femora. Long connexival spines (Fig. 59g).

Locations: MUM, PAM, and VEA.

Habitats: Forest streams, and irrigation canals.

Remarks: This species was commonly distributed in this region. This water bug species was observed in the shaded areas of stream channels, and the edges of irrigation canals. This was previously reported from Kerala (Thirumalai & Radhakrishnan, 1999).

Family Veliidae

Body small, elongate, or oval bugs. Body length from1.5 mm to 18 mm. The body colour varies from brown to black. Ocelli absent. Small legs often with hairy structures.

1. *Microvelia (Microvelia) douglasi* Scott, 1874

(Plate 32: Fig. 60a-60c)

Material examined: 28 ♂; 6 ♀; 12 Nymph; Coll: S. Ranjini.

Diagnostic characters: Brownish-coloured body, length of 1.5 mm and width of 0.44 mm. Head and pronotum dull black in colour. Length of head 0.2 mm. Four segmented antennae. Distinct pronotum with two transverse yellow markings, not extending beyond the apex of pronotum. Pale brown coloured hemelytra (Fig. 60c). Mid tibia shorter than mid femur. Single segmented fore tarsi, whereas mid and hind tarsi two segmented.

Locations: KOA, CHM, OOA, ATY, KOU, MAM, KOE, PAI, KAI, PEM, MKD, KAN, ANL, MLP, PMU, KLY, KUU, AYD, MNR, ESW, KOY, MPA, PLK, and MKL.

Habitats: Lake, agricultural fields, pond, irrigation canals, river, torrential streams, Kole wetlands, backwaters, and man-made pools.

Remarks: This species was widespread and very smaller bugs. This was observed abundant in agricultural fields, rivers, and lakes. This was found in both shaded and nonshaded areas of water bodies. This was previously recorded from Kerala (Thirumalai & Radhakrishnan, 1999).

2. *Microvelia* (*Dilutovelia*) *leveillei leveillei* Lethierry, 1877

(Plate 32: Fig. 61d-61f)

Material examined: 6 ♂; 1 ♀; Coll: S. Ranjini.

Diagnostic characters: Black coloured bug, body length of 1.2 mm. Head dull black in colour. Rostrum reaching up to the base of pro-sternum. (Fig. 61f) Second antennal joint slightly shorter or subequal to first segment, clearly shorter than the third, fore and mid tibia with apical comb.

Locations: ARA, PEI, CHY, and YKA.

Habitats: River, irrigation canals, and pond.

Remarks: This species was poorly known one and rarely found in this region. This was found only in nonshaded areas of aquatic habitats. This was found very abundant in the Pampa River, Pathanamthitta District. This was previously recorded from Andaman and Nicobar Islands, Delhi, Chhattisgarh, Maharashtra, Odisha, Meghalaya, Punjab, Tripura, Bihar, Madhya Pradesh, West Bengal, Karnataka, and Tamil Nadu (Thirumalai, 2002a; Jehamalar & Chandra, 2016; Zettel & Laciny, 2021), but this was the new report from Kerala.

3. *Microvelia albomaculata* Distant, 1909

(Plate 33: Fig. 62a-62c)

Material examined: 4 ♂; Coll: S. Ranjini.

Diagnostic characters: Small, dark brown or black coloured bug, body length of 1.4 mm. Rostrum reaching up to the base of pro-sternum. Four segmented antennae. First and fourth antennal segment longer than second, the second and third antennal segments almost equal in length. Hemelytra largely spotted with greyish white, clavus with a long spot, corium with five spots, two near ends in a longitudinal line and three on the apex in

a transverse line, membrane with two spots, a single large spot on the sub apex and very small spot on inner sub-apex (Fig. 62c).

Location: CHY.

Habitat: River.

Remarks: This species was poorly known one and rare species in this region. This was found only in the nonshaded areas of Chalakkudy River, Thrissur District. This was found near the edges of the rocky shores. This was previously represented from Andaman Nicobar Islands, Madhya Pradesh, and West Bengal (Chandra *et al.*, 2012a; Chandra *et al*., 2012b; Basu *et al.*, 2018c). This recorded for the first time in Kerala and the new report from South India.

4. *Microvelia (Microvelia) diluta* Distant, 1909

(Plate 33: Fig. 63d-63f)

Material examined: 23 ♂; 10 ♀; 1 Nymph, Coll: S. Ranjini.

Diagnostic characters: Glossy brownish black body with the length of 2 mm. Dull black head. Anterior part of the pronotum reddish brown in colour. Hemelytra dull white with the dark brownish veins (Fig. 63f). Three segmented antennae. The second antennal segments always shorter than third and slightly shorter or equal to first segment.

Locations: CHU, VEI, KAA, ADI, CHY, PAM, THR, KAU, ALR, MKD, PMU, KLY, TKS, ANM, AYD, ESW, CRL, KOR, TSY, PLK, and KKE.

Habitats: Pond, lake, forest streams, river, irrigation canals, agricultural fields, Kole wetlands, waterfalls, and man-made pools.

Remarks: This water bug species was commonly found and widely distributed in this region. This was found in both shaded and nonshaded areas of water bodies. This was mostly observed in the ponds, agricultural fields, irrigation canals, forest streams, and

Kole wetlands. This was previously reported from Andaman and Nicobar Islands, Tamil Nadu, Bihar, Delhi, Meghalaya, Maharashtra, Odisha, Tripura, and West Bengal (Chandra *et al.*, 2012a). This was the new report in Kerala.

5. *Neoalardus typicus* Distant, 1903

(Plate 34: Fig. 64a-64c)

Material examined: 2 ♂; 1 ♀; Coll: S. Ranjini.

Diagnostic characters: Dark brownish body, elongated and body length of 4.5 mm. Head and lateral margins of the body brownish yellow in colour dorsally. Pronotum long with silvery white patches on lateral margins (Fig. 64c). Four segmented antennae. Small silvery white patch on second tergite and a pair of median silvery white patch on fourth, sixth, seventh and eighth tergites. Fore tibiae shorter than mid and hind tibiae.

Location: VEI.

Habitat: Lake.

Remarks: This species was poorly known one and very rare in this region. This was found in the inner sides of aquatic vegetation such as grasses, and water lily. This was seen only in the Vellayani Lake, Thiruvananthapuram District. This water bug species was previously recorded from Andaman Nicobar Islands (Thirumalai, 1999b) and recently observed from Meghalaya and Rajasthan (Jehamalar & Chandra, 2020; Zettel & Laciny, 2021). This was recorded for the first time in Kerala and the new report from South India.

6. *Thirumalaia ocularis* Zettel & Laciny, 2021

(Plate 34: Fig. 65d-65f)

Material examined: 6 ♂; 1 ♀; Coll: S. Ranjini.

Diagnostic characters: Body stout, elongated or oval, black in colour. Body length varies from 2 mm to 2.5 mm and width of 0.9 mm. Head narrow with eyes on lateral margins. Two yellowish brown band just below the head. Pronotum rounded (Fig. 65f). Scutellum covered with silvery patches on lateral margins. Dark brownish four segmented antennae. Second antennal segments much shorter than the rest of the three segments. The third and fourth antennal segments equal in length. Legs brownish coloured, slender, and long.

Locations: ARA and CHY.

Habitats: Rivers.

Remarks: This species was poorly known one and rarely observed in this region. This was observed only in the shaded areas of rivers. This was found in two localities such as Pampa River, Pathanamthitta District, and Chalakkudy River, Thrissur District. This water bug species was only recorded from Tamil Nadu (Zettel & Laciny, 2021). This was the new report from Kerala.

7. *Rhagovelia (Neorhagovelia) sumatrensis* Lundblad, 1936

(Plate 35: Fig. 66a-66c)

Material examined: 7 ♂; 16 ♀; 3 Nymph; Coll: S. Ranjini.

Diagnostic characters: Dark black coloured, elongate species. Body length of 2.5 mm and width of 0.9 mm. Pronotum wider than long, anterior region of pronotum with orange, brown transverse band covered by black margins and posterior margins of pronotum straight. Antennae four segmented. First antennal segment longer than the rest of the three segments. Mid femur with three spines. Mid tarsi intensely forked and basally with feather-like plumose (Fig. 66c).

Locations: ANL, MLP, KKL, and CRL.

Habitats: Torrential streams, lake, forest streams, man-made pools, and waterfalls.

Remarks: This species was found more in streams. This was previously reported from Andaman and Nicobar Islands, Madhya Pradesh, and Sikkim, India (Chandra *et al*., 2012a; Chandra *et al*., 2012b; Jehamalar & Chandra, 2016). This was the new report from Kerala and reported for the first time from South India.

Family Mesoveliidae

Semi-aquatic bugs, small, slender, green, or yellow coloured body. Three segmented tarsi. Scutellum exposed and membranous wings. Ocelli present.

1. *Mesovelia vittigera* Horvath, 1895

(Plate 35: Fig. 67d-67f)

Material examined: 36 ♂; 23 ♀; 6 Nymph; Coll: S. Ranjini.

Diagnostic characters: Body elongated and the length ranges from 2.2 mm to 3 mm. Light brownish-yellow or greenish dorsally. Eyes oblong. Two ocelli present in equal distance from the eyes (Fig. 67c). Pronotum wider than head. Rostrum long and reaching beyond the coxa. Four segmented antennae. The fourth segment longer than the third segment. Last abdominal segment with a single median spine. Posterior margin of mid femur fringed with row of black spines.

Locations: CHU, ARA, VEI, KUM, VED, PEI, MUA, PAM, POA, KOU, THR, KOE, PAI, ALR, PEM, KPM, UPM, CMA, AGT, NUI, KAN, CHR, WAL, PMU, KLY, KUU, TKS, MNR, ESW, KLA, PLK, KPU, KKE, and MKL.

Habitats: Pond, river, lake, backwaters, irrigation canals, agricultural fields, and man-made pools.

Remarks: This species was previously known from Andaman Nicobar Islands, Northern and Southern parts of India (Basu *et al.*, 2018c). This was widely distributed and commonly seen in almost all the aquatic habitats of marshy areas of this region. This water bug species was previously recorded from Kerala.

2. *Mesovelia horvathi* Lundblad, 1934

(Plate 36: Fig. 68a-68c)

Material examined: 21 ♂; 23 ♀; 7 Nymph; Coll: S. Ranjini.

Diagnostic characters: Light brownish-yellow or green-coloured body and length of 2 mm. Ocelli present in macropterous forms. Head length 0.3 mm and width 0.36 mm. Length of pronotum 0.57 mm and width 0.63 mm. Rostrum long and reaching the metacoxal part and midway of the body. Inner margin of mid leg with one or two black spines. Fore femur with small hairs. Tarsi three segmented. Male genital segment elongated with group of spines laterally (Fig. 68c). Mala paramere prominently curved.

Locations: CHU, ARA, VEI, CHM, OOA, ATY, PAM, POA, KOU, THR, KOE, ALE, ALR, PEM, THK, CMA, AGT, NLY, KJK, MKD, NUI, KAN, CHR, WAL, ANL, PMU, KLY, KUU, TKS, APM, ANM, PNI, ESW, KOT, KOY, MPA, KPU, and MKL.

Habitats: Pond, river, lake, agricultural fields, irrigation canals, torrential streams, forest streams, and backwaters.

Remarks: This species was previously recorded only from Tamil Nadu and West Bengal (Basu *et al.*, 2018c). This was commonly found and widely distributed in Kerala. This was observed mainly in the shaded regions of aquatic ecosystems and mostly observed in ponds, and lakes. This was the first report from Kerala.

Family Hydrometridae

Extremely slender and short body. The body size varies from 7 to 20mm. Stick-like body and thread-like legs. A very elongated head with long antennae. Eyes located centre of the head.

1. *Hydrometra greeni* Kirkaldy, 1898

(Plate 36: Fig. 69d-69f)

Material examined: 29 ♂; 10 ♀; 4 Nymph; Coll: S. Ranjini.

Diagnostic characters: Yellowish brown body, very small stick-like and length up to 11 mm and 0.5 mm width. Head long and conical clypeus. Long, slender rostrum and the length of 2.4 mm. Very long and thread-like antennae. Third antennal segment longer than the second. A median line present from the eyes to pronotum. Eyes small and located at the mid region of the head. Pronotum long and 0.65 mm in length. Pronotum with row of pits. Scutellum short. Hemelytra with white and dark brown alternative stripes and reaching up to the fourth abdominal segments (Fig. 69f). Legs lean and thread-like. Forelegs shorter, mid, and hind legs equal in size. The terminal genital process sharp and needle-like dorsally.

Locations: ARA, CHM, OOA, KOU, MAM, THR, KAU, PAI, ALR, PEM, NUI, KAN, ANL, MLP, KLY, KUU, ANM, MNR, KVR, MPA, PLK, and MKL.

Habitats: River, agricultural fields, pond, irrigation canals, torrential streams, lake, backwaters, and man-made pools.

Remarks: This species was widespread and commonly observed in aquatic habitat. This was attracted to light and a single specimen was obtained from light near the man-made pools. This was found both shaded and nonshaded areas. This was observed numerous in the agricultural fields and their ditches after harvesting. This species was previously reported from Kerala (Basu *et al.*, 2018c).

2. *Hydrometra butleri* Hungerford & Evans, 1934

(Plate 37: Fig. 70a-70c)

Material examined: 12 ♂; 18 ♀; 7 Nymph; Coll: S. Ranjini.

Diagnostic characters: Elongated brownish body and length up to 10.5 mm. Long and slender antennae. Third antennal segments longer than the second segment. Wings with dark brown patches (Fig. 70c). Pronotum longer than wide. Dark brown or black coloured eyes. Three segmented antennae.

Locations: ARA, CHM, AAU, KOU, ALR, KAI, UPM, WAL, ANL, MLP, ESW, PLK, MKL, and TKD.

Habitats: River, agricultural fields, rock pools, pond, irrigation canals, torrential streams, lake, and man-made pools.

Remarks: This species was commonly found in aquatic ecosystems. This was found both shaded and nonshaded part of aquatic ecosystems. This was observed numerous in irrigation canals and agricultural fields. This was previously known from South India and from Kerala (Thirumalai & Radhakrishnan, 1999; Basu *et al.*, 2018c).

Family Hebridae

Small, discreet, predacious, velvety body. Commonly called "velvet bugs". The size ranges from 1.5 mm to 3 mm. Four-segmented antennae. A distinct marking on the wings. Legs short and equally spaced.

1. *Timasius fenestratus* Zettel, 2013

(Plate 37: Fig. 71d-71f)

Material examined: 4 ♂; 1 ♀; Coll: S. Ranjini.

Diagnostic characters: Body small and dark brown in colour. Body length of 2 mm. Head directed forward. Prominent eyes located at the basal side of the head. Slender and four segmented antennae. Pronotum with two sub-median carinae and collar on the anterior part. Wings with distinct white markings (Fig. 71f). Well-developed tarsal claws.

Locations: KAU, and WAL.

Habitats: Pond and lake.

Remarks: This species was collected from the channels of lake. It was found in the grassy areas of aquatic habitat. It was nonshaded and used by the humans for fishing. This water bug species was poorly known one and reported only from Madhya Pradesh and Chhattisgarh (Jehamalar & Chandra, 2016). This was the first report from Kerala.

INFRAORDER LEPTOPODOMORPHA

Family Leptopodidae

Body delicate, elongate or ovoid. Head with 4 to 6 cephalic setae present. Large eyes and prominent. A pair of ocelli present on the bulged tubercle. Short rostrum, not reaching beyond the prosternum. Antennae very long and slender. Enlarged pronotum. Three segmented tarsi. Metathoracic scent gland well developed.

1. *Valleriola cicindeloides* Distant, 1908

(Plate 38: Fig. 72a-72c)

Material examined: 1 ♂; Coll: S. Ranjini & M. Manoj

Diagnostic characters: Elongate body, length of 5.2 mm, greyish brown in colour, Median tubercle and a pair of ocelli present on the head. Eyes large located on the lateral margins of the head (Fig. 72c). The third antennal segments very longer than the first antennal segments. Pronotum longer than wide (Fig. 72c). Four prominent dark greyish-brown markings on the pronotum, not reaching at the apex. Wings with prominent dark brown and yellow markings, not reaching beyond the apex of the hemelytra. All the tarsi three segmented.

Location: APM.

Habitats: Forest streams.

Remarks: This species was previously studied from Bihar, West Bengal, Madhya Pradesh, and Andaman Nicobar Island (Chandra *et al*., 2012a; Chandra *et al*., 2012b). They were found on the rocks near the streams of the forest area of Attappallam, Palakkad District, which was human inhabited area but rarely disturbed streams. This was the new report from Kerala and reported for the first time in South India.

2.5 Discussion

Kerala, one of the smallest and tropical states of India, with very good biodiversity, blessed with two monsoons such as Southwest monsoon and Northeast monsoon. Geographically, this state is a strip of land bordered by eastern side with Western ghats, and on the western side with Arabian sea. The maximum width of the state from north to south is 70 km and length wise 560 km and divided in to three regions such as high land, middle land, and low land. Due to two monsoons, our state provided with good number of aquatic ecosystems such as lakes, ponds, backwaters and 44 rivers.

The previous status of water bugs from Kerala are 85 species under 46 genera and 14 families. Very few studies were carried out earlier from this region but, the knowledge was limited, and the only information was available from the Silent Valley and Kasaragod area. Thirumalai (1986) studied the fauna of aquatic bug families of Gerridae and Notonectidae from Northeast Western Ghats, Silent Valley, Kerala. According to this study, a total of 9 species belongs to 6 genera under the Family Gerridae and 2 species belongs to single genera under the Family Notonectidae were recorded. Thirumalai & Radhakrishnan (1999) reported the Northern most region of Kerala, i.e., Kasaragod District was represented only 8 species and 6 genera belongs to the three families such as Family Gerridae, Notonectidae and Belostomatidae. The taxonomic key provided only for these 8 species from Kasaragod District and the systematic list was also given in this study.

The present study recorded 65 species belongs to the 34 genera and 14 families of aquatic and semi-aquatic bugs from selected habitats of Kerala. 85 species were documented from the earlier checklist from Zoological Survey of India. From this

checklist, 35 species of water bugs were recorded in the present study. This study revealed that 30 species belonging to 18 genera and 12 families were recorded for the first time in Kerala. From the newly recorded species, 13 species belonging to 18 genera and 12 families were reported for the first time in South India. Lists of previously recorded (35 species), new records from South India (13 species) & Kerala (30 species) in the present study were given in Appendix 4. Thus, a total of 115 species of water bugs were recorded including my study from Kerala till this date. The distribution map of new recorded 30 species from Kerala were provided in Appendix 5. The 14 families of collected water bugs and their common names were shown in Appendix 6.

This study revealed that 13 new records from South India, such as *Sigara (Vermicorixa) kempi* Hutchinson, 1940, *Micronecta ludibunda* Breddin, 1905, *Micronecta khasiensis* Hutchinson, 1940, *Anisops tahitiensis* Lundblad, 1934, *Anisops occipitalis* Breddin, 1905, *Paraplea liturata* Fieber, 1844, *Tiphotrephes indicus* Distant, 1910, *Ptilomera (Ptilomera) assamensis* Hungerford & Matsuda, 1965, *Ptilomera (Ptilomera) laticaudata* Hardwicke, 1823, *Microvelia albomaculata* Distant, 1909, *Neoalardus typicus* Distant, 1903, *Rhagovelia (Neorhagovelia) sumatrensis* Lundblad, 1936, and *Valleriola cicindeloides* Distant, 1908.

S. (Vermicorixa) kempi was poorly known species and this was previously reported from Arunachal Pradesh, Himachal Pradesh, Meghalaya, Sikkim, Uttar Pradesh, and West Bengal (Basu *et al*., 2018c). This species was widely distributed in the Himalayan foothills (Basu *et al*., 2018c), but this was the first-time report from South India. It was found in pond and river of plane land. *M. ludibunda* was reported from Assam and West Bengal (Thirumalai, 2007; Basu *et al.*, 2018c) and observed from ponds, lakes, and forested pools. But this was the new report from South India. This species can be easily identified by its wing pattern. This was poorly known species, and this was observed in seven localities of selected habitats of Kerala such as lake, pond, agricultural fields, backwaters, Irrigation canals, and man-made pools. *M. khasiensis* was previously documented only from Assam, West Bengal, and Meghalaya (Thirumalai, 2007; Basu *et al.*, 2018c). Basu *et al*. (2018c) revealed that it was seen in rock pools. This species was very small and found in four locations of Kerala. This was observed in ponds, agricultural

fields, and lakes in the present study. *A. tahitiensis* was only reported earlier from Andaman Nicobar Island and West Bengal (Jehamalar & Chandra, 2013c; Jehamalar *et al*., 2014a). This study reported from two locations of Kannur and Kasaragod Districts, Northeast Kerala and only seen in man-made pools. *A. occipitalis* was poorly known species. This was recorded earlier in Andaman Nicobar Islands and Meghalaya (Jehamalar & Chandra, 2013c; Jehamalar & Chandra, 2020). In this study, this species was observed in the river and the pond of two localities of Kerala. *P. liturata* was rare species and reported for the first time in South India. This was previously recorded from Assam and West Bengal (Saha & Gupta, 2019; Saha *et al.*, 2020). This was found in lakes, ponds, and agricultural fields in the present study. *T. indicus* was poorly known species from this region. This species was previously reported from Maharashtra, West Bengal, and Uttar Pradesh (Basu *et al*., 2018c). This was only observed in a large fish rearing pond from Thasrak, Palakkad District, Kerala. *Ptilomera (P.) assamensis* was rare species and new records from South India. This was only observed from the forest streams of Nelliyampathy hills, Palakkad District and Kakkavayal, Kozhikode District, Kerala. This was previously reported only from North India such as Assam, West Bengal, and Arunachal Pradesh (Basu *et al*., 2018c). *Ptilomera (P.) laticaudata* was rarely distributed species in Kerala. This was previously reported from the Sikkim, Assam, Himachal Pradesh, and West Bengal (Jehamalar *et al*., 2018c). This species was observed only in the river, Kuruva island, Wayanad District, Kerala. *M. albomaculata* was poorly known species from this region. This was observed only in the river of Chalakkudy, Thrissur District, Kerala. This species was reported earlier from Andaman Nicobar Islands, Madhya Pradesh, and West Bengal (Chandra *et al*., 2012a; Chandra *et al*., 2012b; Basu *et al.*, 2018c). *N. typicus* was rare species from this tropical region. This was only found in Vellayani Lake, Thiruvananthapuram District, Kerala. This species was previously recorded from Andaman Nicobar Islands (Thirumalai, 1999) and recently observed from Meghalaya and Rajasthan (Jehamalar & Chandra, 2020; Zettel & Laciny, 2021). *R. (Neorhagovelia) sumatrensis* was rare species and observed from four localities of Kerala. This species was found large numbers in the streams of hilly areas. This was reported earlier from Andaman and Nicobar Islands, Madhya Pradesh, and Sikkim, India (Chandra *et al*., 2012a; Chandra *et al*., 2012b; Jehamalar & Chandra, 2016). *V.*

cicindeloides was rare species in this region. This species was previously documented from Bihar, West Bengal, Madhya Pradesh, and Andaman Nicobar Island (Chandra *et al*., 2012a; Chandra *et al*., 2012b). This was found on the rocks near the streams of the forest area of Attappallam, Palakkad District, Kerala.

The studied aquatic habitats have been grouped in to twelve ecosystems such as rivers, ponds, waterfalls, forest streams, torrential streams, quarry & rock pools, irrigation canals, agricultural fields & Kole wetlands, lakes (including dams, check dams, & regulators), backwaters, mangroves, and man-made pools by the presence/absence of observed species. The species present in each different aquatic habitats were shown in Appendix 7. Some species of water bugs were observed only in specific habitat and some other species were found in different types of habitats. From the 65 studied species, pond ecosystems had the greatest number of species (45 species) and least number of species was observed in mangroves (2 species). Based on the abundance of different types of heteropteran species, 45 species can be considered as pond species. It throws a light for the importance of conservation of natural pond ecosystems. Angelibert *et al.* (2004) revealed that recently started getting some attention given only for ponds, because of their management and conservation closely linked to an understanding of the ecology and biodiversity of the same (Gaston *et al.*, 2005).

Sixteen species inhabited only a specific type of habitat. The species *P. nostras*, *Ptilomera (P.) laticaudata*, *M. albomaculata*, and *T. ocularis*, were found only in river. *S. (Tropocorixa) promontoria*, and *T. indicus*, were observed in pond. *R. varipes varipes*, *H. indicus*, *P. indicus*, and *M. communoides*, *M. darjeelingensis*, and *N. typicus*, were seen in lakes. *R. elongata*, *Ptilomera (P.) assamensis,* and *V. cicindeloides*, were found in forest streams. The species *A. tahitiensis*, was found only in the man-made pools near the coastal region of Northeast part of Kerala. The rest of the species was found in different selected habitats of Kerala.

Based on the habitat groups, six species such as *L. indicus*, *S. (Vermicorixa) kempi*, *A. paranigrolineatus*, *A. occipitalis*, *C. productus*, and *T. fenestratus*, were present in two aquatic habitats. From this species, *L. indicus*, *S. (Vermicorixa) kempi*, *A.*

paranigrolineatus, *A. occipitalis*, and *T. fenestratus*, were commonly observed in pond ecosystems. 9 species such as *R. varipes atropha*, *M. desertana desertana*, *M. khasiensis*, *A. bouvieri*, *A. barbatus*, *A. sardeus sardeus*, *P. liturata*, *Ventidius (V.) aquarius*, and *M.* (*Dilutovelia*) *leveillei leveillei*, were found only in three different aquatic habitats.

Some species were distributed only in high altitude regions. A total of 24 species such as *N. sappho*, *L. griseus*, *L. ruber*, *D. molestus*, *D. rusticus*, *Ptilomera (P.) agroides*, *Ventidius (V.) aquarius*, *Microvelia (M.) diluta*, *R. (Neorhagovelia) sumatrensis*, *M. vittigera*, *P. frontalis*, *Ptilomera (P.) laticaudata*, *M. haliploides*, *Microvelia (M.) douglasi*, *M.* horvathi, *H. greeni*, *A. breddini*, *A. niveus*, *L. anadyomene*, *Ptilomera (P.) assamensis*, *C. pilipes*, *C. productus*, *E. ciliata*, and *R. elongata*, were observed in high altitudinal regions viz., Idukki District (1200 m), Wayanad District (2100 m), and Nelliyampathy hills (1572 m) of Palakkad District, Kerala. *R. elongata* was found only in forest streams of Idukki District; *Ptilomera (P.) laticaudata* was observed only in the Kabani River of Wayanad District. *Ptilomera (P.) assamensis* was observed in forest streams of Nelliyampathy hills of Palakkad.

S. (Vermicorixa) kempi was recorded only in Northeast India from high altitudinal lakes, rivers, and pools across the Himalayan foothills (Basu *et al.*, 2016b). Another species of *S. (Tropocorixa) promontoria* was represented only in Peninsular India (Basu *et al.*, 2016b). Basu *et al.* (2018c) reported that these two species were collected from forest area. In contradictory to the statement made by Basu *et al.* (2016b, 2018c) regarding on the above said two species was also observed from plane lands of pond and river of Palakkad District, Kerala.

N. typicus was only observed from the Vellayani Lake, Thiruvananthapuram District. Thirumalai (1999c) listed this species from Andaman and Nicobar Islands. It was recently reported from Meghalaya and Rajasthan (Jehamalar & Chandra, 2020; Zettel & Laciny, 2021). This species was also a first report from South India. Morphologically this species has close resemblance to the species *Aquulavelia oculata* Thirumalai, 1999. *N. typicus* has truncated head and is larger in size than *A. oculata.*

Some species of water bugs were attracted to the source of light. Basu *et al.* (2018c) reported that the following species *H. greeni*, *N. parvulus*, and *M. haliploides* were attracted to light. The present study revealed that in addition to the above said three species, two more species *Limnogonus (L.) fossarum fossarum*, and *Limnogonus (L.) nitidus* also showed attraction to light.

There are some reports (Thangjam *et al.*, 2022; Chakraborty, 2015; Haldhar *et al.*, 2021; Prabha & Jain, 2019) state that Northeast India are unique hotspot for insect biodiversity. The present study revealed that, in the case of observed 65 water bug species, about 50 percent species was similar with the aquatic heteropterans of Northeast India, even though far from each other.

PLATE – 2


a


b


c


d


e


f

Figure 5. (a-l): Different aquatic habitats selected for the study: (a) River; (b) Pond; (c) Waterfall; (d) Forest streams; (e) Torrential streams; (f) Quarry & rock pool.

PLATE – 3


g


h


i


j


k


l

Figure 5. Different aquatic habitats selected for the study: (g) Irrigation canal; (h) Agricultural field & Kole wetland; (i) Lake (including dam, check dam, & regulator); (j) Backwater; (k) Mangrove; (l) Man-made pool.

PLATE – 4


a


b


c


d


e


f

Figure 6. (a-f): Collection of specimens during field studies.

PLATE – 5

a

b

c

Figure 7. (a-c): Sorting of specimens and preserved in a bottle containing 70 % alcohol.

PLATE – 6

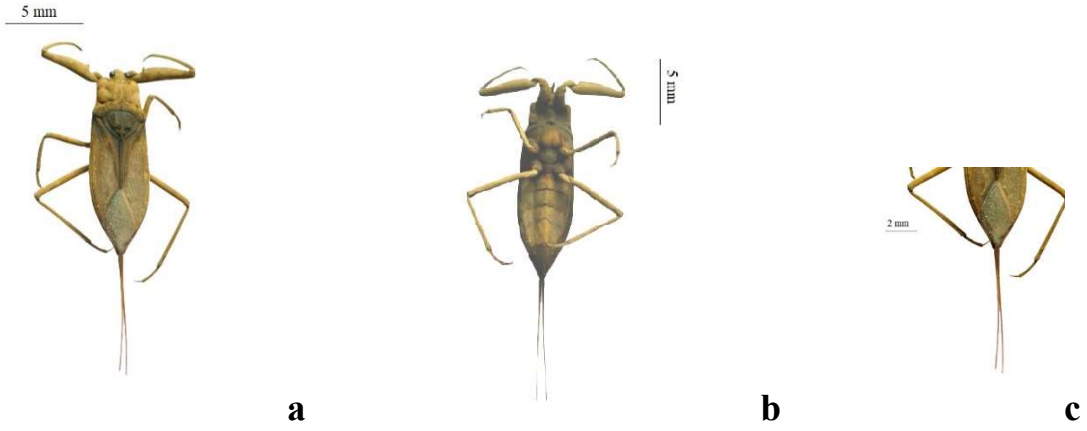

Figure 8. *Laccotrephes griseus* Guerin-Meneville, 1844: a. Dorsal view, b. Ventral view, c. Respiratory tube.

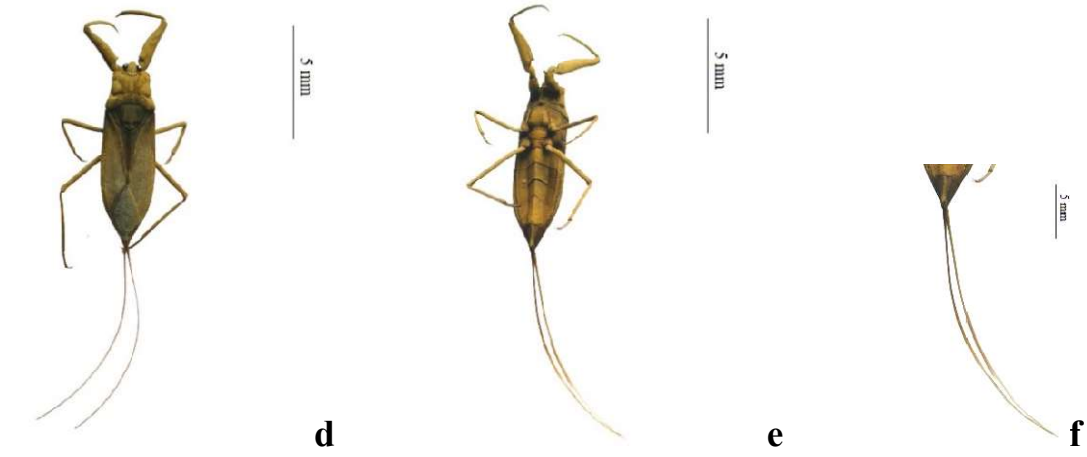

Figure 9. *Laccotrephes ruber* Linnaeus, 1764: d. Dorsal view, e. Ventral view, f. Respiratory tube.

PLATE – 7

Figure 10. *Cercotmetus pilipes* Dallas, 1850: a. Dorsal view, b. Head and forelegs, c. Marking patterns on legs.

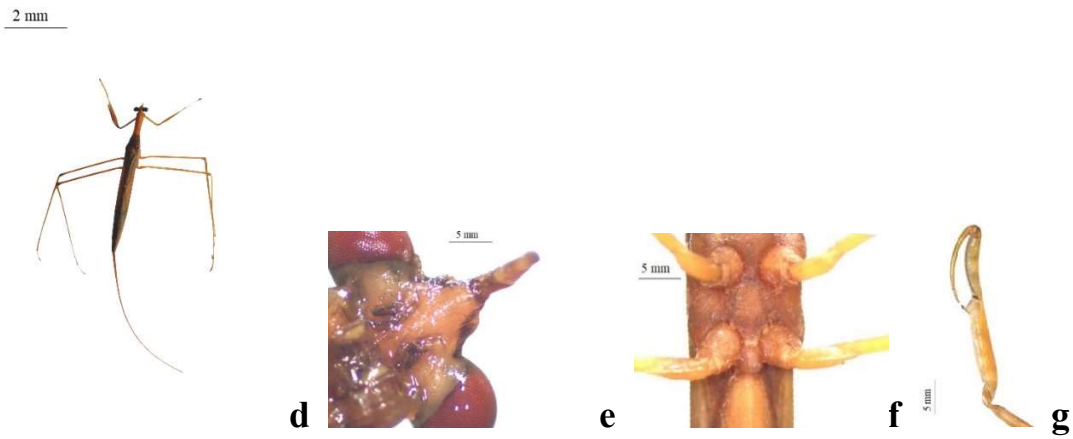

Figure 11. *Ranatra varipes atropha* Montandon, 1903: d. Dorsal view, e. Antennae, f. Metasternal keel, g. Foreleg.

PLATE – 8

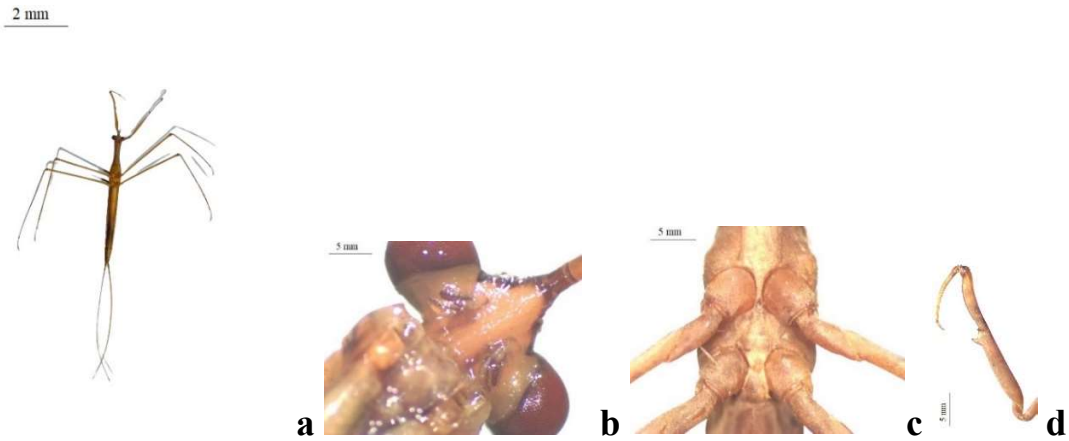

Figure 12. *Ranatra varipes varipes* Stal, 1861: a. Dorsal view, b. Antennae, c. Metasternal keel, d. Foreleg.

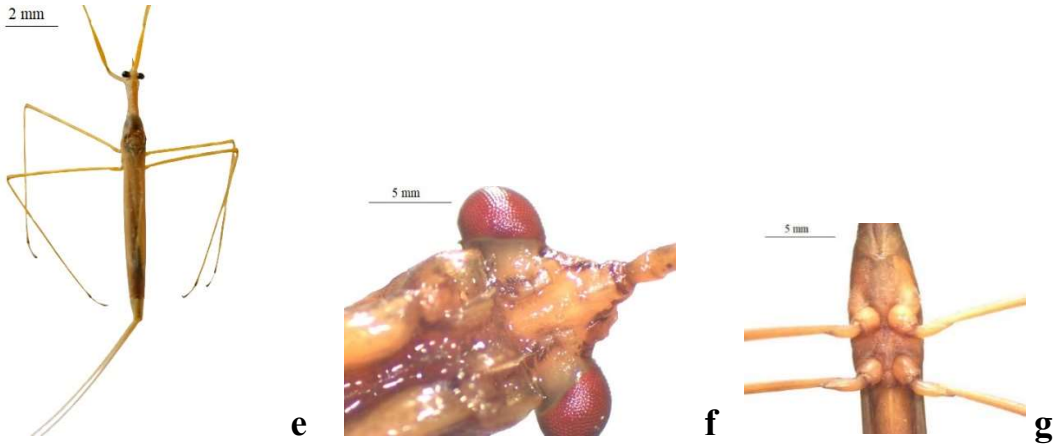

Figure 13. *Ranatra filiformis* Fabricius, 1790: e. Dorsal view, f. Antennae, g. Metasternal keel.

PLATE – 9

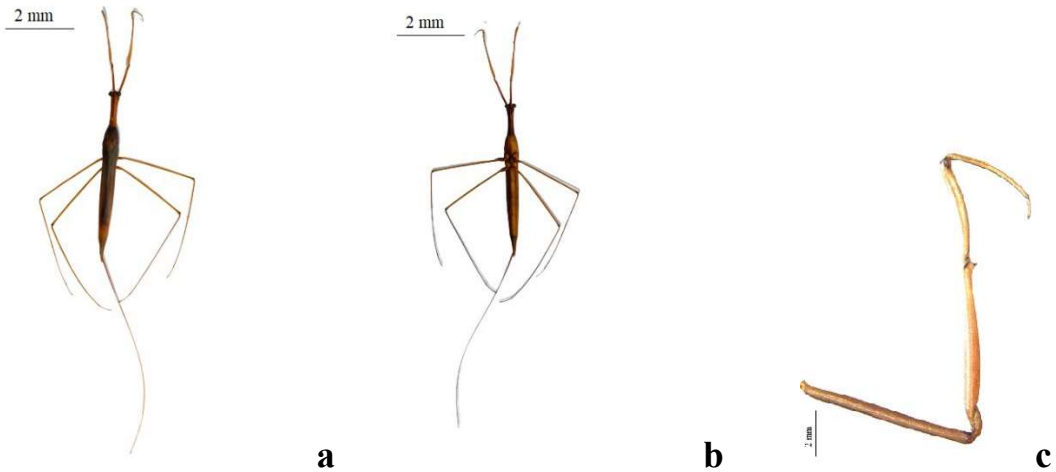

Figure 14. *Ranatra elongata* Fabricius, 1790: a. Dorsal view, b. Ventral view, c. Foreleg.

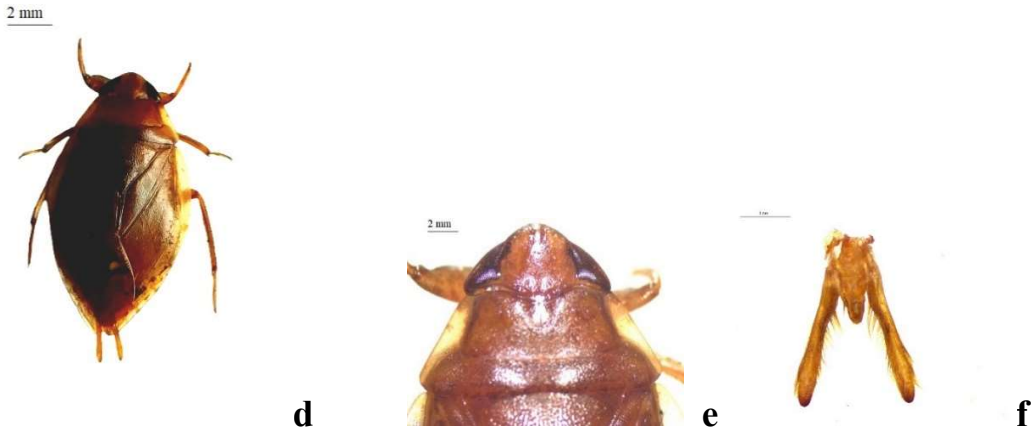

Figure 15. *Diplonychus molestus* Dufour, 1863: d. Dorsal view, e. Head and pronotum, c. Male genitalia with respiratory straps.

PLATE – 10

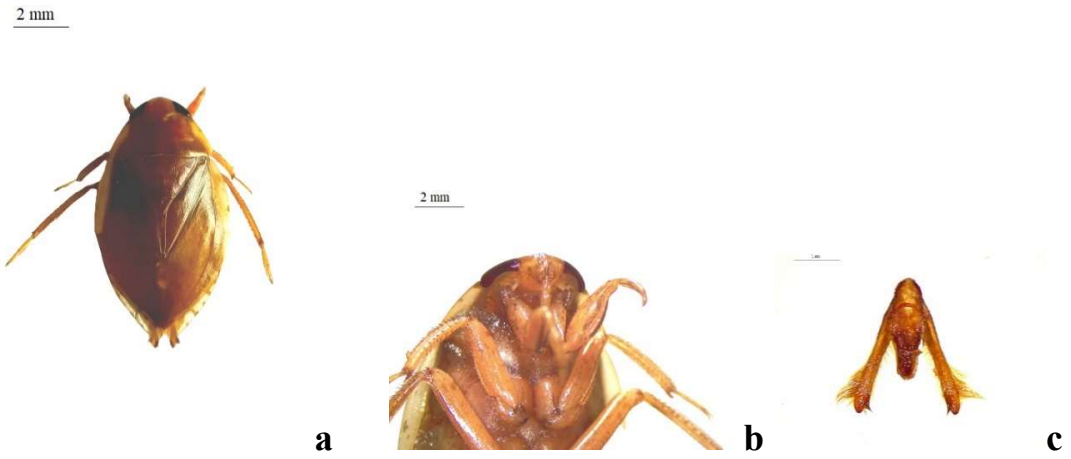

Figure 16. *Diplonychus rusticus* Fabricius, 1781: a. Dorsal view, b. Ventral view showing forelegs, c. Male genitalia with respiratory straps.

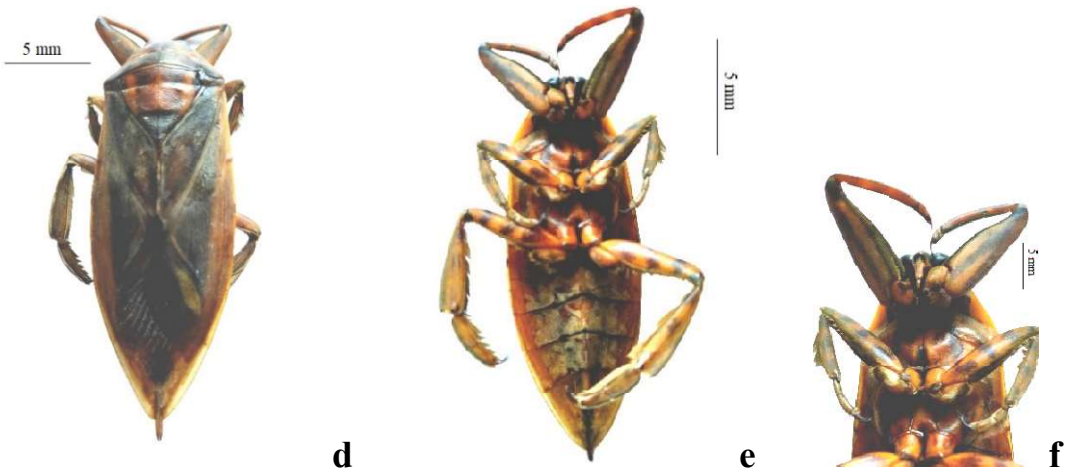

Figure 17. *Lethocerus indicus* Lepeletiler & Serville, 1825: d. Dorsal view, e. Ventral view, f. Ventral view showing forelegs.

PLATE – 11

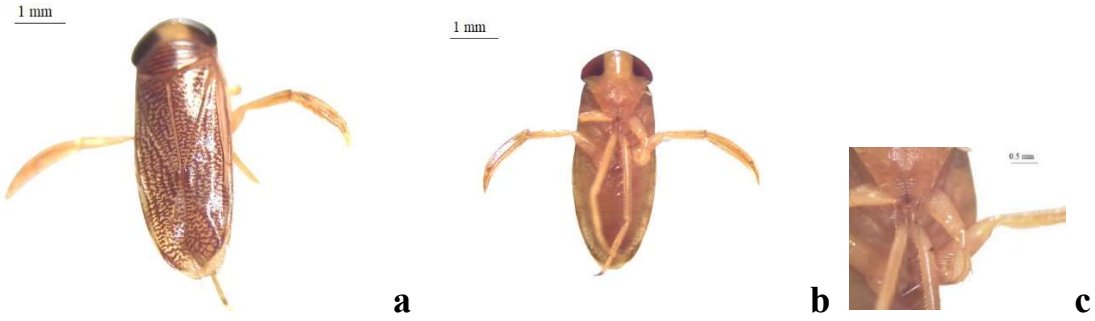

Figure 18. *Sigara (Vermicorixa) kempi* Hutchinson, 1940:
a. Dorsal view, b. Ventral view, c. Foreleg.

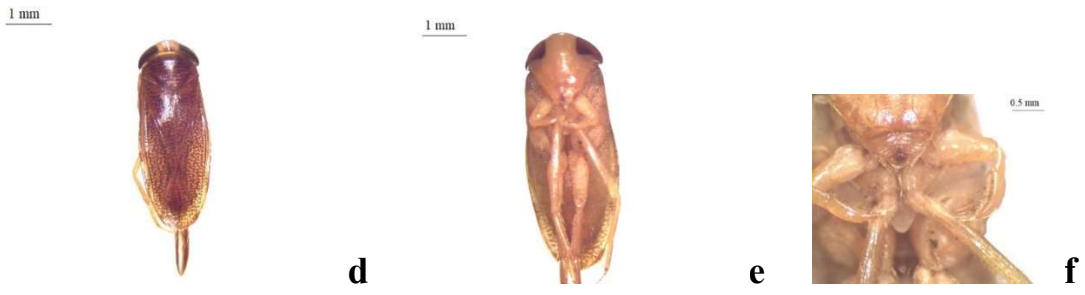

Figure 19. *Sigara (Tropocorixa) promontoria* Distant, 1910:
d. Dorsal view, e. Ventral view, f. Forelegs.

PLATE – 12

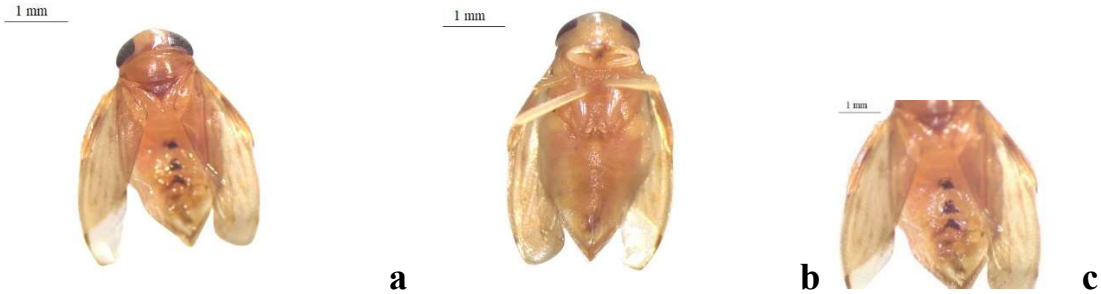

Figure 20. *Micronecta scutellaris scutellaris* Stal, 1858: a. Dorsal view, b. Ventral view, c. Abdominal markings.

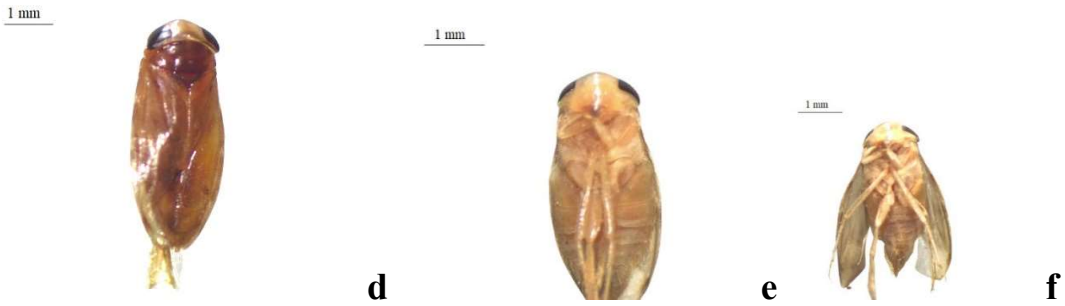

Figure 21. *Micronecta quadristrigata* Breddin, 1905: d. Dorsal view, e. Ventral view. f. Ventral showing wing pattern.

PLATE – 13

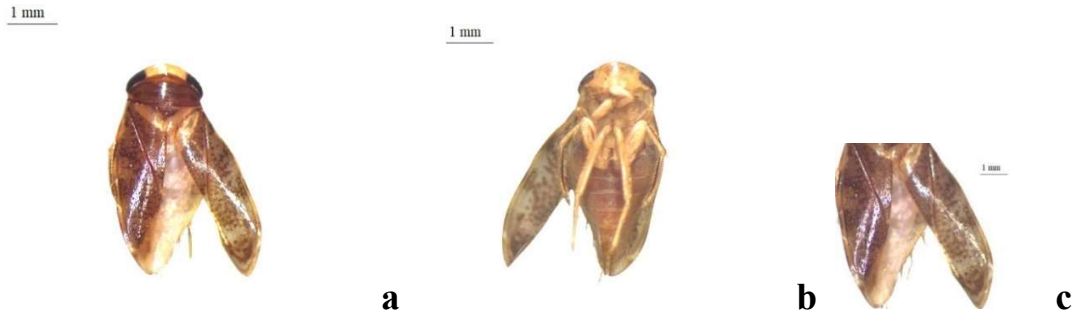

Figure 22. *Micronecta haliploides* Horvath, 1904: a. Dorsal view, b. Ventral view, c. Marking patterns on wings.

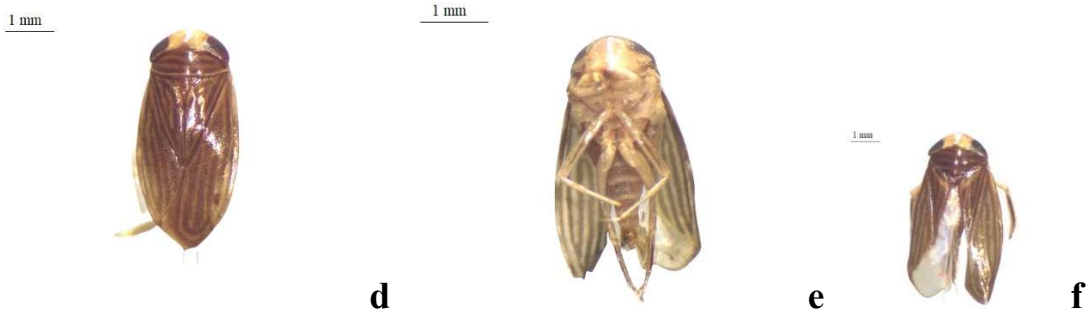

Figure 23. *Micronecta ludibunda* Breddin, 1905: d. Dorsal view, e. Ventral view, f. Marking pattern on wings.

PLATE – 14

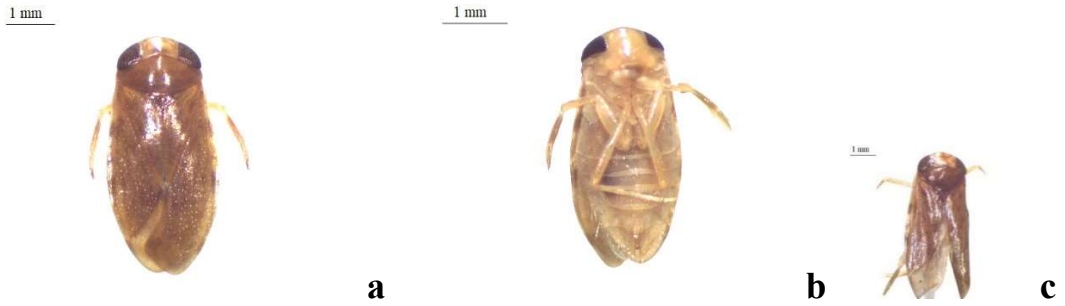

Figure 24. *Micronecta desertana desertana* Distant, 1920:
a. Dorsal view, b. Ventral view, c. Wing pattern and clouded spots on vertex.

Figure 25. *Micronecta khasiensis* Hutchinson, 1940: d. Dorsal view,
e. Ventral view, f. Ventral view showing forelegs.

PLATE – 15

Figure 26. *Helocoris indicus* Montandon, 1897: a. Dorsal view, b. Ventral view, c. Ventral view showing forelegs.

Figure 27. *Anisops nasutus* Fieber, 1851: a. Dorsolateral view, e. Ventral view, f. Dorsal view showing cephalic projection.

PLATE – 16

a **b** **c**

Figure 28. *Anisops breddini* Kirkaldy, 1901: a. Dorsal view, b. Ventral view, c. Head in lateral view.

d **e** **f**

Figure 29. *Anisops bouvieri* Kirkaldy, 1904: d. Dorsal view, e. Ventral view, f. Cephalic horn.

PLATE – 17

Figure 30. *Anisops barbatus* Brooks, 1951: a. Dorsal view, b. Ventrolateral view, c. Ventrolateral view showing hindlegs.

Figure 31. *Anisops sardeus sardeus* Herrich-Shaffer, 1850: d. Dorsal view, e. Lateroventral view, f. Lateral view showing cephalic horn.

PLATE – 18

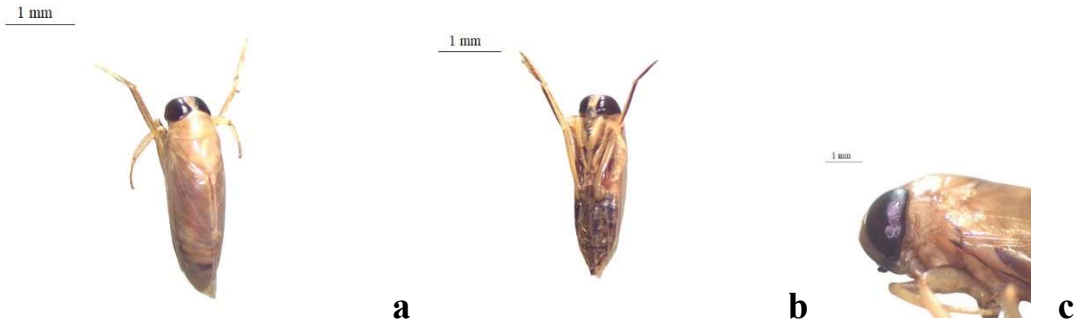

Figure 32. *Anisops niveus* Fabricius, 1775: a. Dorsal view, b. Ventral view, c. Lateral view of head.

Figure 33. *Anisops paranigrolineatus* Brooks, 1951: d. Dorsal view, e. Ventral view, f. Lateral view.

PLATE – 19

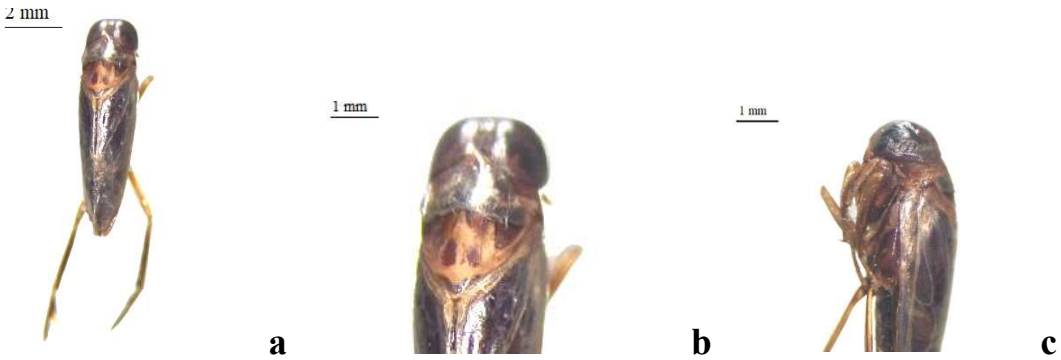

Figure 34. *Anisops tahitiensis* Lundblad, 1934: a. Dorsal view, b. Dorsal view showing scutellum, c. Lateral view of head.

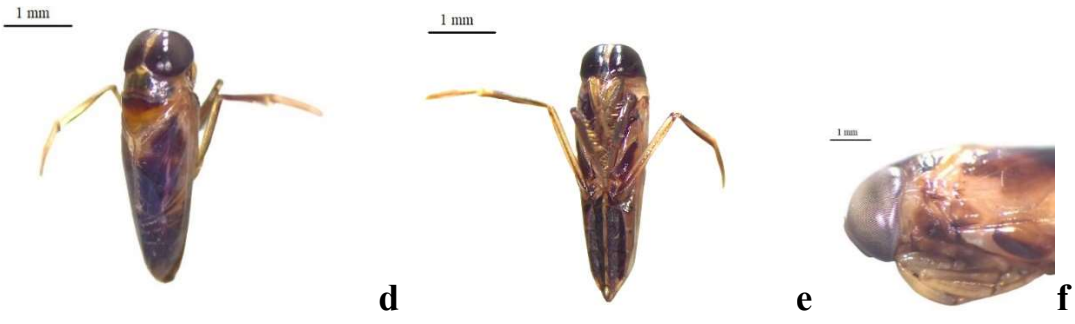

Figure 35. *Anisops occipitalis* Breddin, 1905: d. Dorsal view, e. Ventral view, f. Lateral view of head.

PLATE – 20

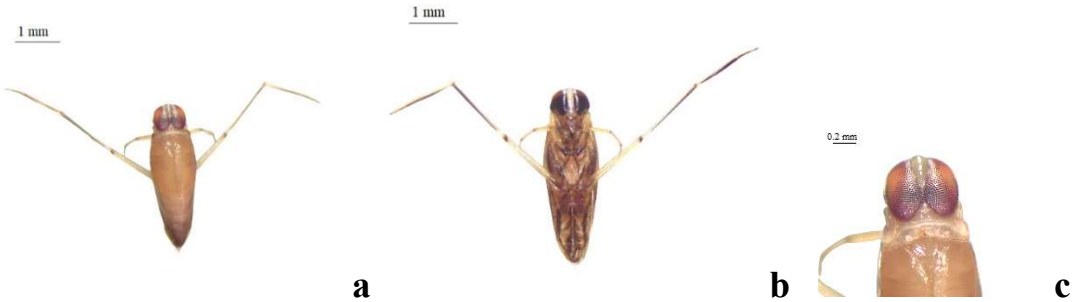

Figure 36. *Nychia sappho* Kirkaldy, 1901: a. Dorsal view, b. Ventral view, c. Compound eyes.

Figure 37. *Enithares ciliata* Fabricius, 1798: d. Dorsal view, e. Ventral view, f. Mid tarsal segments with claws.

PLATE – 21

Figure 38. *Paraplea frontalis* Fieber, 1844: a. Dorsal view, b. Ventral view, c. Marking pattern of head.

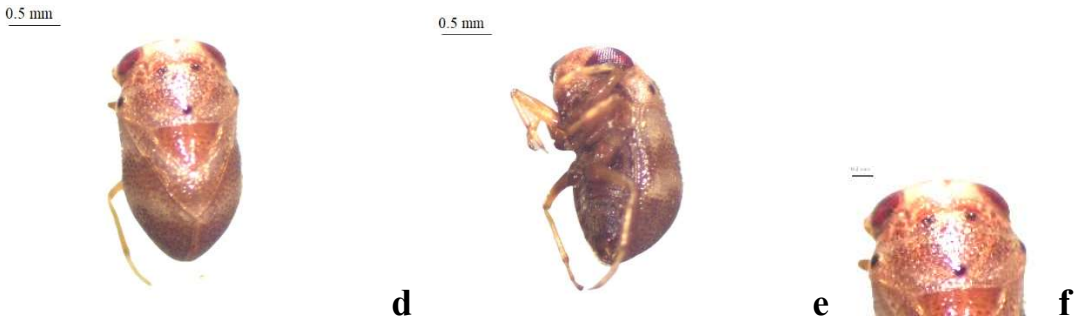

Figure 39. *Paraplea liturata* Fieber, 1844: d. Dorsal view, e. Lateral view, f. Marking patterns on pronotum.

PLATE – 22

Figure 40. *Tiphotrephes indicus* Distant, 1910: a. Dorsal view, b. Ventral view, c. Front view of head.

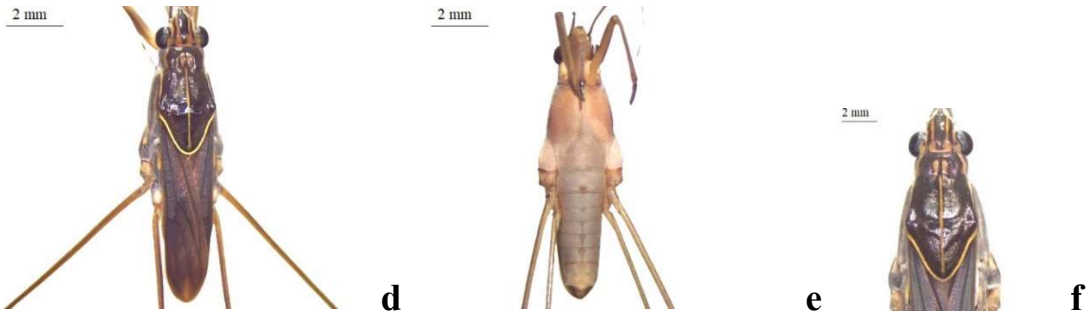

Figure 41. *Limnogonus (Limnogonus) fossarum fossarum* Fabricius, 1775: d. Dorsal view, e. Ventral view, f. Marking pattern on head and pronotum.

PLATE – 23

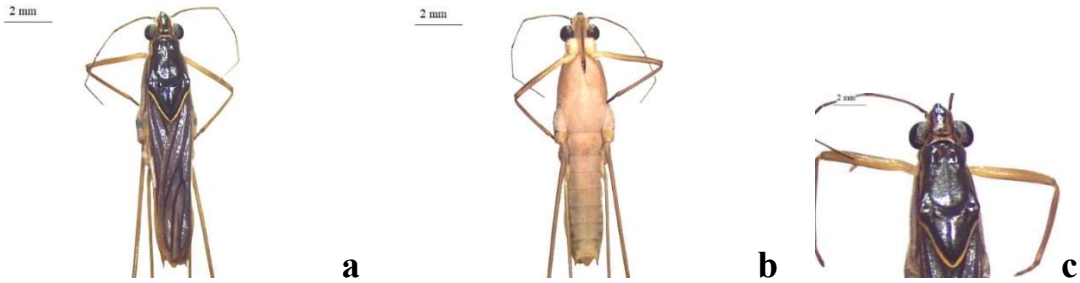

Figure 42. *Limnogonus (Limnogonus) nitidus* Mayr, 1865:
a. Dorsal view, b. Ventral view, c. Head and pronotum.

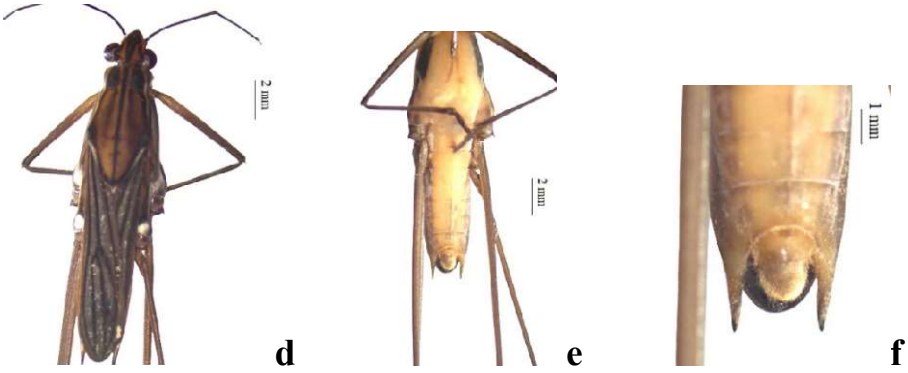

Figure 43. *Limnometra fluviorum* Fabricius, 1798: d. Dorsal view,
e. Ventral view, f. Genital segment showing connexival spines.

PLATE – 24

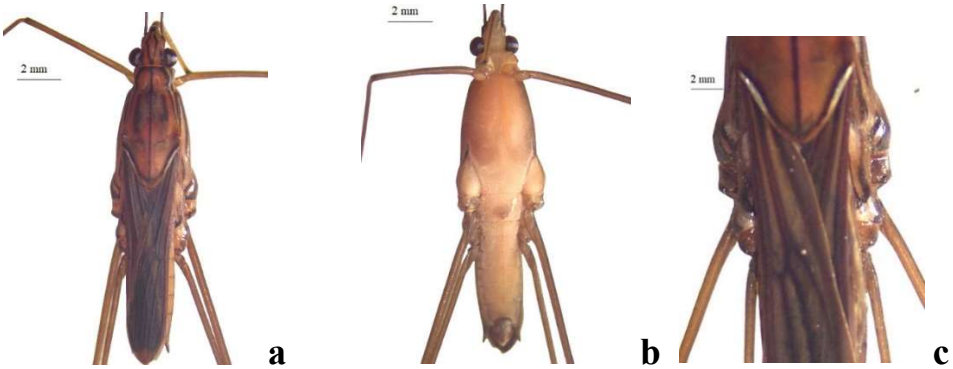

Figure 44. *Limnometra anadyomene* Kirkaldy, 1901: a. Dorsal view, b. Ventral view, c. Dorsal view showing mesocoxal part.

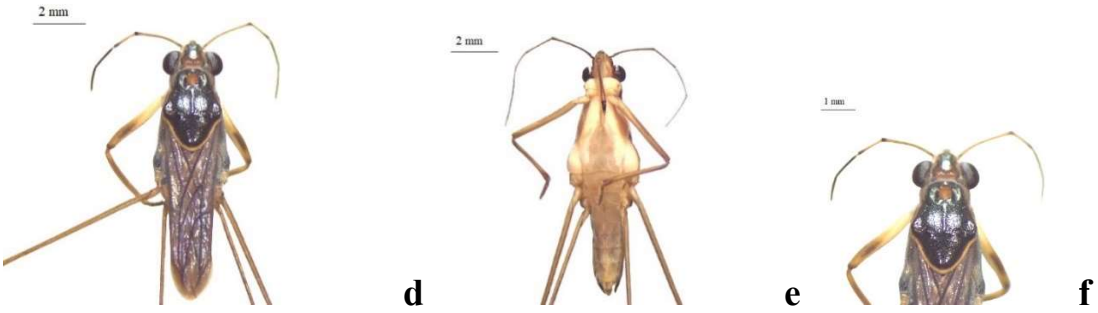

Figure 45. *Neogerris parvulus* Stal, 1859: d. Dorsal view, e. Ventral view, f. Head and pronotum.

PLATE – 25

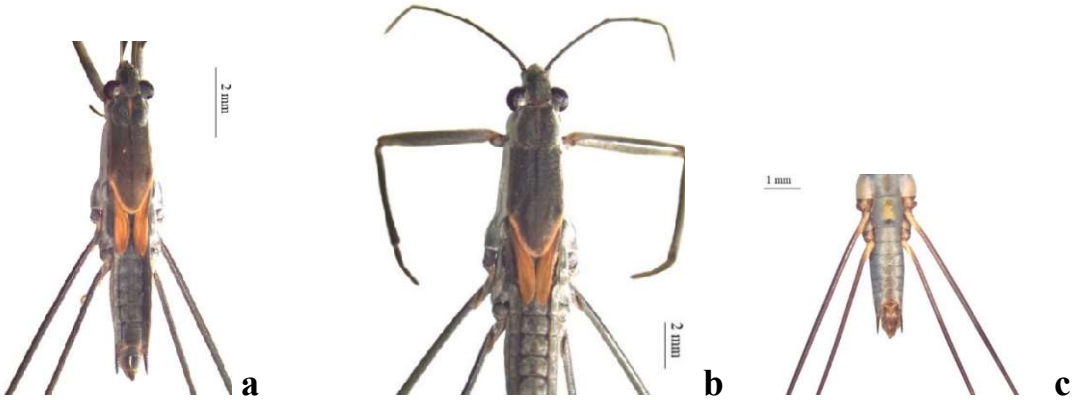

Figure 46. *Aquarius adelaides* Dohrn, 1860: a. Dorsal view, b. Head and pronotum, c. Ventral view of genital segment.

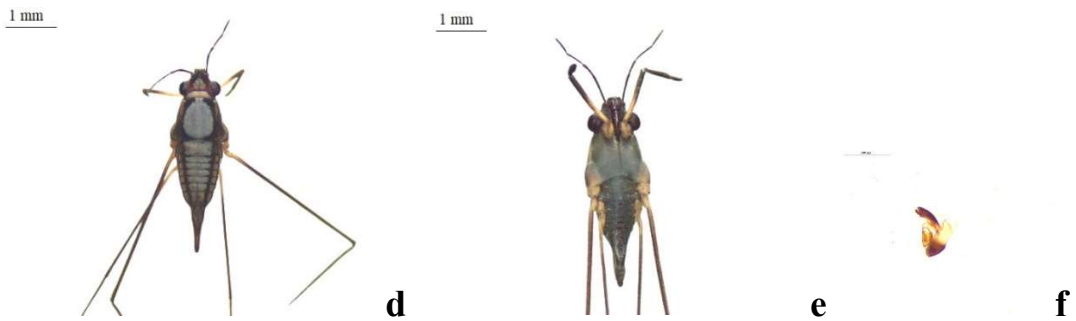

Figure 47. *Rhagadotarsus kraepelini* Breddin, 1905: d. Dorsal view, e. Ventral view, f. Male genitalia dissected showing pygophore and endosomal sclerite.

PLATE – 26

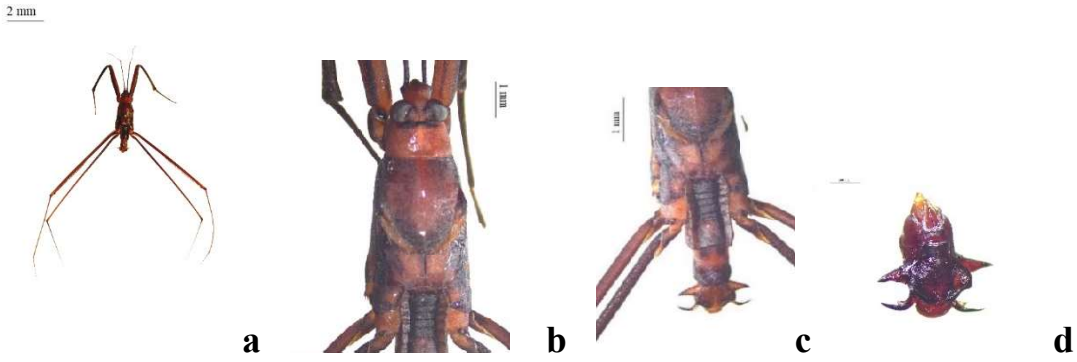

Figure 48. *Ptilomera (Ptilomera) agroides* Schmidt, 1926: a. Dorsal view, b. Head and pronotum, c. Dorsal view of genital segment, d. Male genital segment dissected.

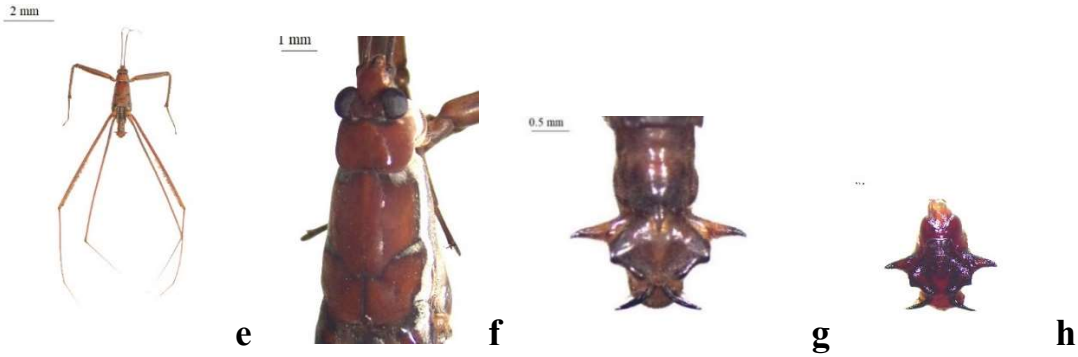

Figure 49. *Ptilomera (Ptilomera) assamensis* Hungerford & Matsuda, 1965: e. Dorsal view, f. Head and pronotum, g. Dorsal view of genital segment, h. Male genital segment dissected.

PLATE – 27

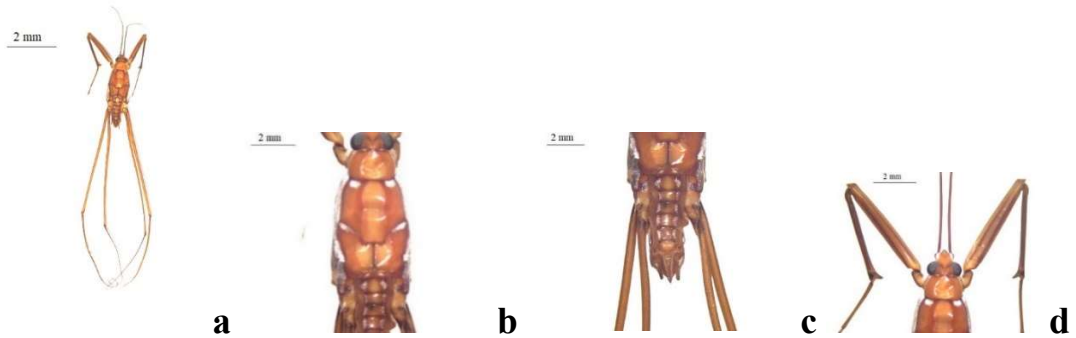

Figure 50. *Ptilomera (Ptilomera) laticaudata* Hardwicke, 1823: a. Dorsal view, b. Head and pronotum, c. Dorsal view of female genital segment, d. Head and forelegs.

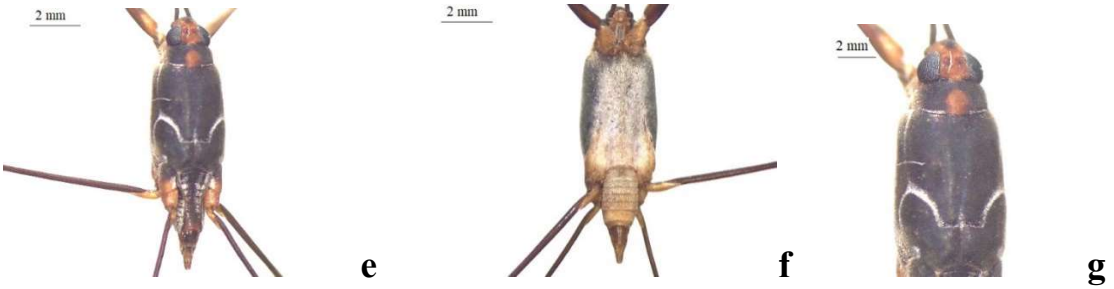

Figure 51. *Pleciobates nostras* Thirumalai, 1986: e. Dorsal view, f. Ventral view, g. Head and pronotum.

PLATE – 28

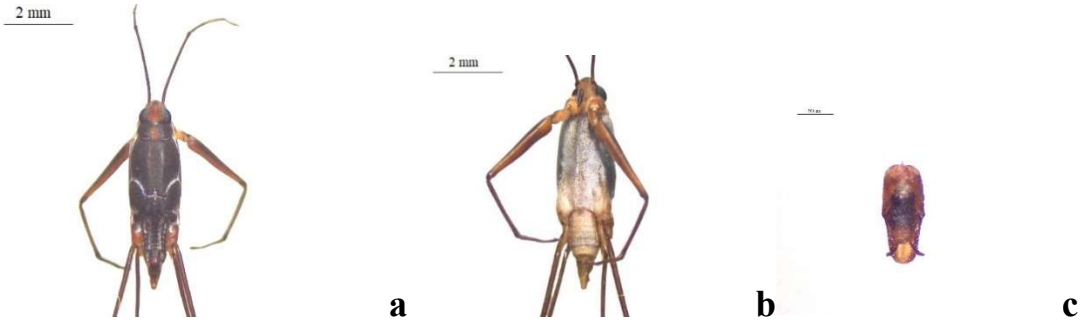

Figure 52. *Pleciobates indicus* Thirumalai, 1986: a. Dorsal view, b. Ventral view, c. Male genital segment dissected.

Figure 53. *Amemboa kumari* Distant, 1910: d. Dorsal view, e. Ventral view, f. Foreleg showing hair clumps.

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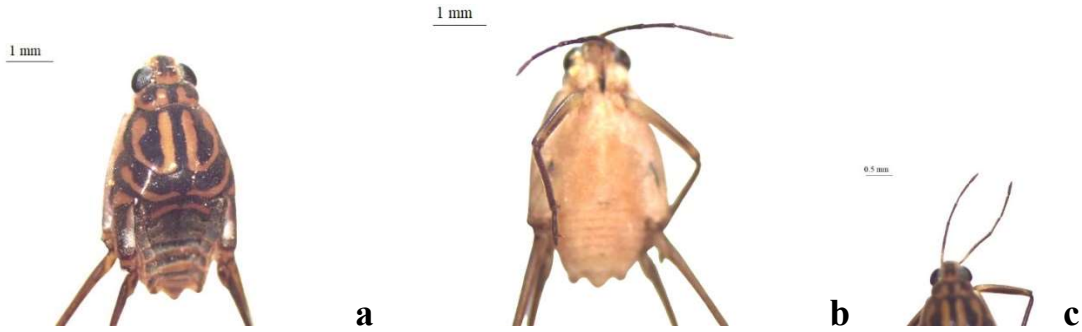

Figure 54. *Metrocoris darjeelingensis* Basu, Polhemus & Subramanian, 2016: a. Dorsal view, b. Ventral view, c. Antennae.

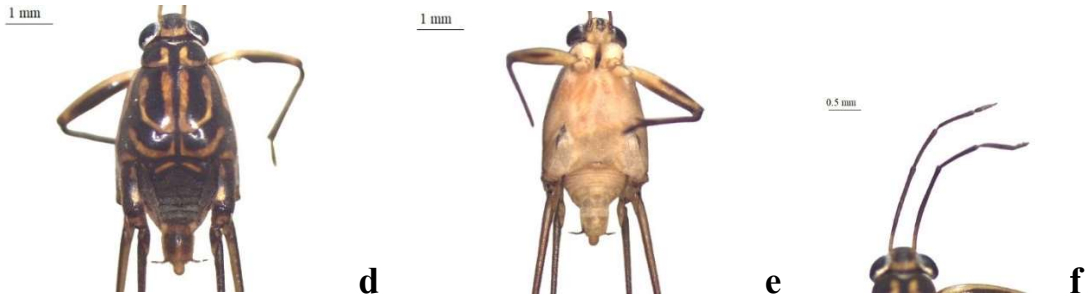

Figure 55. *Metrocoris communoides* Chen & Neser, 1993: d. Dorsal view, e. Ventral view, f. Antennae.

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Figure 56. *Ventidius (Ventidius) aquarius* Distant, 1910: a. Dorsal view, b. Ventral view, c. Dorsal view of marking pattern of macropterous.

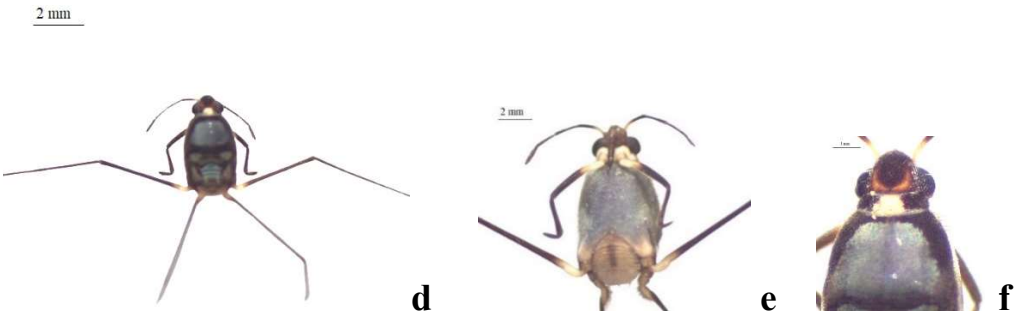

Figure 57. *Naboandelus signatus* Distant, 1910: d. Dorsal view, e. Ventral view, f. Dorsal view showing head markings.

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Figure 58. *Lathriobates raja* Distant, 1910: a. Dorsal view, b. Ventral view, c. Lateral view of marking patterns.

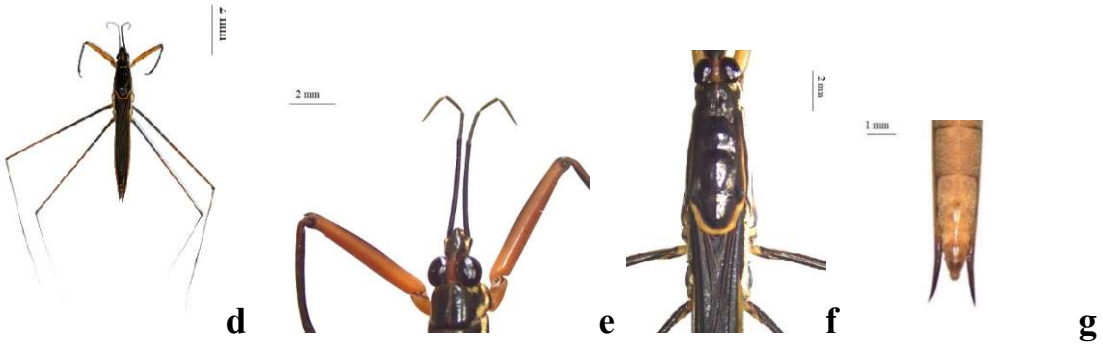

Figure 59. *Cylindrostethus productus* Spinola, 1840: d. Dorsal view, e. Head showing antennae, f. Pronotum, g. Ventral view of genital segment.

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Figure 60. *Microvelia (Microvelia) douglasi* Scott, 1874: a. Dorsal view, b. Ventral view, c. Dorsal view showing wings.

Figure 61. *Microvelia* (*Dilutovelia*) *leveillei leveillei* Lethierry, 1877: d. Dorsal view, e. Ventral view, f. Ventral view showing rostrum.

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Figure 62. *Microvelia albomaculata* Distant, 1909: a. Dorsal view, b. Ventral view, c. Marking pattern of wings.

Figure 63. *Microvelia (Microvelia) diluta* Distant, 1909: d. Dorsal view, e. Ventral view, f. Wings with vein pattern.

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Figure 64. *Neoalardus typicus* Distant, 1903: a. Dorsal view, b. Ventral view, c. Head and pronotum.

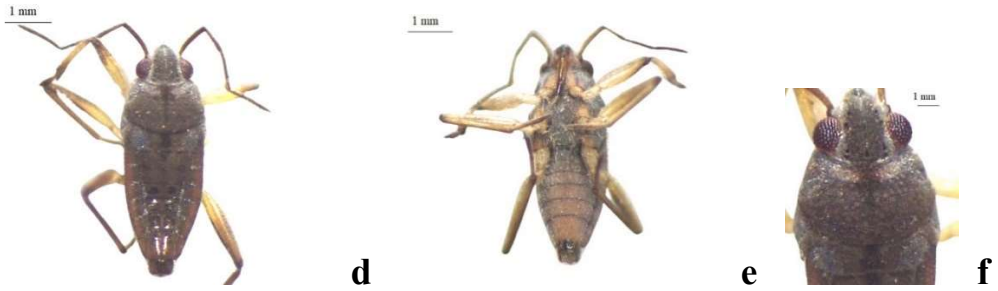

Figure 65. *Thirumalaia ocularis* Zettel & Laciny, 2021: d. Dorsal view, e. Ventral view, f. Head and pronotum.

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Figure 66. *Rhagovelia (Neorhagovelia) sumatrensis* Lundblad, 1936: a. Dorsal view, b. Ventral view, c. Middle leg.

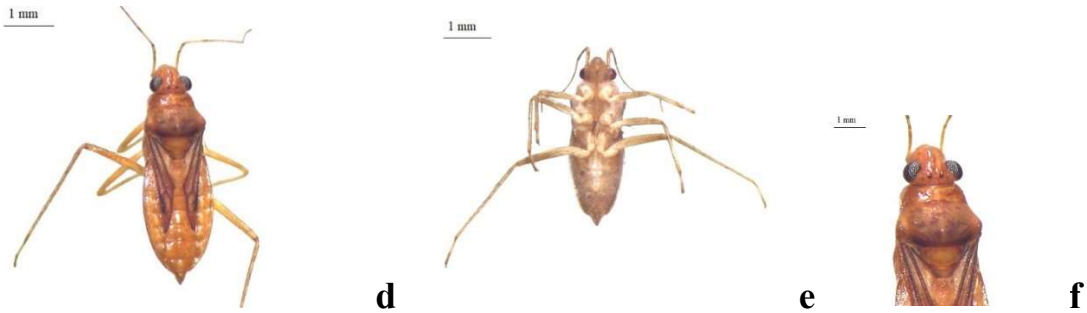

Figure 67. *Mesovelia vittigera* Horvath, 1895: d. Dorsal view, e. Ventral view, f. Head and pronotum.

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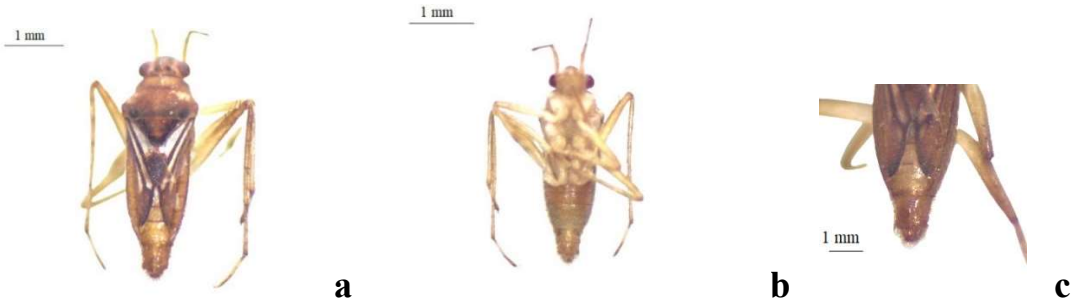

Figure 68. *Mesovelia horvathi* Lundblad, 1934: a. Dorsal view, b. Ventral view, c. Dorsal view of genital segment.

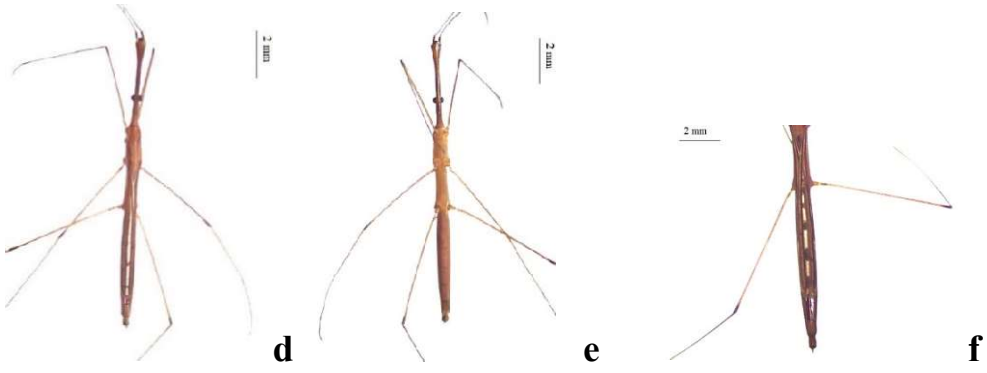

Figure 69. *Hydrometra greeni* Kirkaldy, 1898: d. Dorsal view, e. Ventral view, f. Marking pattern of wings.

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Figure 70. *Hydrometra butleri* Hungerford & Evans, 1934:
a. Dorsal view, b. Ventral view, c. Marking pattern of wings.

Figure 71. *Timasius fenestratus* Zettel, 2013: d. Dorsal view,
e. Ventral view, f. Marking pattern of wings.

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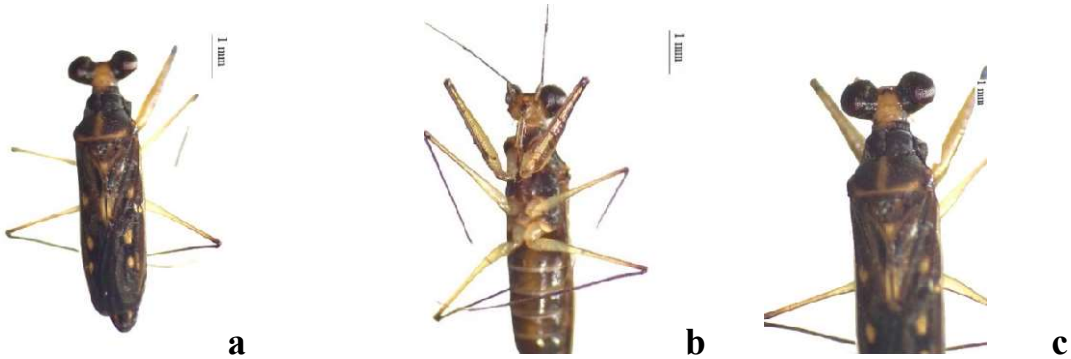

Figure 72. *Valleriola cicindeloides* Distant, 1908: a. Dorsal view, b. Ventral view, c. Head and pronotum.